MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

VOL. XXVII. ANNUAL SUMMARY, 1899. No. 13

INTRODUCTION.

The present Summary for 1899 is based essentially upon data received from about 150 regular stations, 28 regular Canadian stations, and a number of voluntary stations whose annual summaries were received in time. A revised chart of total annual precipitation will be published in the Annual Report of the Chief of the Weather Bureau when the data from all voluntary stations have been received. The statistical tables and charts have been prepared under the supervision of Prof. A. J. Henry, Chief of the Division of Meteorological Records. The tables of movements of high and low areas and the summary of flood movements have been prepared by Dr. H. C. Frankenfield, Forecast Official.

Annual summaries were not received from all West Indian stations in time for use in this report.

FORECAST DIVISION.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

HIGHS AND LOWS OF 1899.

During 1899 the data regarding highs and lows were compiled according to the plan pursued in compiling those of the years 1895 to 1898, inclusive. The mean velocities for 1899 were slightly higher than those for the preceding four years, the excess, however, being confined to the six colder months, with a maximum in January for the highs of 30.8 miles an hour, and of 36.5 miles in December for the lows.

On the whole the highs and lows present few points of difference, when compared with those of the preceding four years. They appear within narrow limits over a certain district, and disappear over another equally well defined, moving from the one district to the other with a remarkably uniform velocity. These statements can readily be verified by an inspection of the tables following:

Summary of highs and lows, 1899.

Month.	Highs.							Lows.						
	Mean first observed.		Mean last observed.		Path, average.		Hourly velocity.	Mean first observed.		Mean last observed.		Path, average.		Hourly velocity.
	Lat. N.	Long. W.	Lat. N.	Long. W.	Length.	Duration, days.		Lat. N.	Long. W.	Lat. N.	Long. W.	Length.	Duration, days.	
	°	°	°	°	*Miles.*			°	°	°	°	*Miles.*		
Jan	49	110	38	72	2,668	4.0	30.8	43	109	46	61	2,518	3.1	35.2
Feb	53	113	41	67	3,225	5.9	27.1	37	111	45	60	3,040	4.0	33.3
Mar .. .	51	111	42	70	2,370	4.4	22.7	45	115	47	60	3,303	4.8	30.2
Apr	43	123	42	75	3,182	7.1	19.4	42	116	44	74	2,662	4.6	25.0
May....	47	113	40	70	2,860	5.0	24.9	47	115	46	73	2,737	5.1	23.6
June ...	45	118	37	75	3,004	5.7	22.0	50	117	46	63	3,295	5.9	24.0
July ...	51	110	43	72	2,335	4.7	20.4	47	107	48	64	2,211	4.7	20.9
Aug....	45	117	46	66	2,940	5.9	24.3	44	109	45	81	1,957	5.2	16.7
Sept....	46	122	41	70	3,762	6.7	23.5	48	114	47	66	2,880	4.3	27.9
Oct	46	113	44	69	2,660	4.8	23.3	38	104	47	77	2,079	3.6	25.3
Nov....	47	113	42	78	2,473	4.4	25.2	42	109	44	69	2,310	3.8	25.9
Dec	44	106	40	86	1,675	2.2	30.5	43	105	42	73	1,869	2.2	36.5
Means..	47	114	41	72	2,763	5.1	24.5	44	111	46	68	2,572	4.8	27.0

The accompanying table exhibits a compilation of the data on these principles. At the end of each year the average for the six cold and six warm months has been computed, and there is added here a summary of the five years.

Summary, 1895 *to* 1899, *inclusive.*

Year.	Highs.					Lows.				
	Mean first observed.		Mean last observed.		Hourly velocity.	Mean first observed.		Mean last observed.		Hourly velocity.
	Lat. N.	Long. W.	Lat. N.	Long. W.		Lat. N.	Long. W.	Lat. N.	Long. W.	
	°	°	°	°		°	°	°	°	
1895.....	47	110	39	80	24	45	107	45	73	26
1896.....	48	111	42	75	24	46	111	46	74	26
1897.....	48	113	38	78	24	46	110	46	71	26
1898.....	46	114	40	72	25	45	111	46	67	26
1899.....	47	114	41	72	24	44	111	46	68	27
Means....	47	112	40	75	24	45	110	46	71	26

Mean velocity by cold and warm months is as follows:

Year.	Mean velocity.			
	Highs.		Lows.	
	Cold.	Warm.	Cold.	Warm.
	Miles.	*Miles.*	*Miles.*	*Miles.*
1895.....	27	22	30	23
1896.....	25	23	28	24
1897.....	25	22	29	22
1898.....	26	23	29	23
1899.....	27	22	31	23
Mean.....	26	22	29	23

H. C. Frankenfield, Forecast Official.

RIVER AND FLOOD SERVICE.

By H. C. FRANKENFIELD.

The River and Flood Service has been somewhat extended during the past year in order to meet growing demands. Reports are now received from nearly 200 river stations and 42 rainfall stations. The following table briefly summarizes the work of the year in a purely statistical way. Detailed reports may be found in the regular monthly Reviews.

Heights of rivers above zeros of gages, 1899.

Stations.	Highest water. Stage.	Highest water. Date.	Lowest water. Stage.	Lowest water. Date.	Mean stage.	Annual range.
Mississippi River.	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul Minn	11.0	June 22, 23..	3.5	Aug. 6-9	6.6	7.5
Reeds Landing, Minn	8.9	June 18. ...	−0.6	Feb. 8, 13, 15, 19.	2.9	9.5
La Crosse, Wis	11.8	June 18.....	2.5	Oct. 14	6.0	9.3
North McGregor, Iowa	14.4	June 19-21..	1.0	Feb. 1, 13, 14 ...	5.2	13.4
Dubuque, Iowa	14.8	June 22-24..	2.1	Oct. 19	5.0	12.7
Leclaire, Iowa	9.4	June 24-26..	−0.4	Dec. 18	3.7	9.8
Davenport, Iowa	11.9	June 25.....	0.6	Dec. 19-22	5.0	11.3
Muscatine, Iowa	13.3	June 26, 27..	1.1	Dec. 24, 25	6.0	12.2
Galland, Iowa	6.7	June 29.....	0.4	Dec. 27, 28	2.9	6.3
Keokuk, Iowa	12.1	June 29.....	−1.7	Dec. 28	4.8	13.8
Hannibal, Mo	15.0	May 23	−1.5	Dec. 30	5.7	16.5
Grafton, Ill	18.3	May 25	0.8	Dec. 31	7.6	17.5
St. Louis, Mo	25.6	Apr. 27	−0.7	Feb. 1	11.4	26.3
Chester, Ill	21.4	Apr. 27	−1.3	Feb. 2	8.9	22.7
Memphis, Tenn	35.3	Mar 30, Apr 1, Apr. 3-5, 7-10.	0.5	Oct. 31-Nov. 2..	15.4	34.8
Helena, Ark	46.9	Apr. 10-13 ..	1.7	Nov. 1-3...	21.9	45.2
Arkansas City, Ark	48.6	Apr. 15-20 ..	1.0	Nov. 2-5	23.4	47.6
Greenville, Miss.	43.0	Apr. 17-20 ..	1.2	Nov. 2-6	20.1	41.8
Vicksburg, Miss	47.3	Apr. 16-24 ..	−1.6	Nov. 5-7	22.4	48.9
New Orleans, La	17.2	Apr. 22	2.5	Nov. 3, 4	8.8	14.7
Missouri River.						
Bismarck, N. Dak	21.2	Apr. 14	0.5	Dec. 5	5.4	20.7
Pierre, S. Dak	15.9	Apr. 19	0.7	Dec. 14, 17	5.8	15.2
Sioux City, Iowa	18.4	Apr. 23	4.7	Oct. 9	9.1	13.7
Omaha, Nebr	18.5	Apr. 25	4.3	Dec. 24	9.4	14.2
St. Joseph, Mo	12.6	Apr. 27	−1.1	Dec. 29-31	4.0	13.7
Kansas City, Mo	23.3	Apr. 28	5.2	Dec. 31	10.9	18.1
Boonville, Mo	20.0	Apr. 30	3.1	Dec. 24	9.4	16.9
Hermann, Mo	18.9	Apr. 26, 27 ..	1.6	Feb. 3	9.5	17.3
Illinois River.						
Peoria, Ill	15.1	Mar. 22	3.4	Aug. 22-24, 27-29	6.9	11.7
Youghiogheny River.						
Confluence, Pa	9.5	May 18	0.1	Oct. 28, 29.....	2.6	9.4
West Newton, Pa	13.2	May 18	0.0	Aug. 24-26..... Oct. 20-31	1.9	13.2
Allegheny River.						
Warren, Pa	7.2	Dec. 20	0.0	Aug. 13-Sept. 1. Sept. 7-30 ..... Oct. 27, Nov. 1..	1.6	7.2
Oil City, Pa	8.2	Dec. 20	−0.2	Oct. 1	2.1	8.4
Parkers Landing, Pa	9.5	Dec. 20	0.0	Aug. 30, 30 ..... Sept. 1	2.4	9.5
Monongahela River.						
Weston, W. Va	17.3	Jan. 6	−2.0	Oct. 22-25.....	0.2	19.3
Fairmont, W. Va	20.3	Jan. 7	0.1	Oct. 26-29.....	2.8	20.2
Greensboro, Pa	22.0	Jan 7, Mar 6	6.0	Oct. 22-31.....	8.5	16.0
Lock No. 4. Pa.	25.9	Mar. 6.....	5.6	Aug. 26	9.5	21.3
Conemaugh River.						
Johnstown, Pa	8.7	May 18	0.5	Oct. 27-30	2.1	8.2
Red Bank Creek.						
Brookville, Pa	3.5	May 18	−0.2	Aug 30-Sept. 1.	0.8	3.7
Beaver River.						
Ellwood Junction, Pa	6.9	Jan. 15	−0.7	Nov. 15-17	0.9	7.6
Great Kanawha River.						
Charleston, W. Va	41.5	Mar. 6.....	3.2	Dec. 30, 31.....	7.7	38.3
New River.						
Hinton, W. Va	13.8	Mar. 5.....	1.0	Aug. 25-29 ..... Oct. 23-29 ..... Dec. 8-10	2.7	12.8
Cheat River.						
Rowlesburg, W. Va	10.0	Mar. 5.....	−1.2	Oct. 26-Nov. 1.	2.6	11.2
Ohio River.						
Pittsburg, Pa	22.0	Mar. 6.....	2.3	Feb. 3, 12, 16, 17..	6.7	19.7
Davis Island Dam, Pa	19.7	Mar. 6.....	1.5	Oct. 29....	6.2	18.2
Wheeling, W. Va	28.2	Mar. 7.....	1.1	Oct. 22-31.....	7.8	27.1
Parkersburg, W. Va	29.0	Mar. 8.....	1.5	Oct. 26-28.....	9.1	27.5
Point Pleasant, W. Va	47.2	Mar. 7.....	1.1	Oct. 27-31.	10.5	46.1
Catlettsburg, Ky	56.3	Mar. 7	0.8	Oct 29-Nov. 1..	13.4	55.5
Portsmouth, Ohio	55.8	Mar. 7	2.2	Oct. 29-Nov. 1..	14.5	53.6
Cincinnati, Ohio	57.4	Mar. 8.....	3.4	Nov. 2	16.5	54.0
Louisville, Ky	32.8	Mar. 10.....	2.3	Sept. 5, 6.....	8.2	30.5
Evansville, Ind	40.4	Apr. 5.....	1.6	Oct. 30-Nov. 1..	14.5	38.8
Paducah, Ky	43.8	Apr. 4, 5	0.5	Oct. 13-16..... Nov. 5-10.....	15.2	43.3
Cairo, Ill	46.2	Mar. 30 to Apr. 4.	3.0	Oct. 15, 16.....	21.5	43.2
Muskingum River.						
Zanesville, Ohio	20.0	Jan. 16.....	5.6	Sept. 17, Oct. 28.	8.3	14.4
Miami River.						
Dayton, Ohio.	10.5	Jan. 15.....	0.5	Oct. 1, 22..... Nov. 30.....	1.8	10.0
Wabash River.						
Mount Carmel, Ill	19.5	Jan. 23.....	0.3	Sept. 30-Oct. 18.	5.1	19.2
Licking River.						
Falmouth, Ky	27.2	Mar. 5.....	0.3	Sept. 23-28..... Oct. 11-19.....	3.8	26.9
Clinch River.						
Speers Ferry, Va	16.4	Mar. 19.....	−0.8	Oct. 26-27.....	1.3	17.2
Clinton, Tenn	28.0	Feb. 6, 7.....	1.4	Nov. 21, 22.....	6.5	26.6
Tennessee River.						
Knoxville, Tenn	28.8	Mar. 20....	−1.3	Nov. 21-23... ..	2.6	30.1
Kingston, Tenn	27.1	Mar. 21	0.3	July 15, 16 ..... Aug. 21-23 ..... Sept. 6, 7, 11-14, 18-20, 28-30.	3.9	26.8
Chattanooga, Tenn	40.0	Mar. 22.....	0.8	Oct. 27, 28..... Nov. 22	7.0	39.2
Bridgeport, Ala	28.0	Mar. 23	0.1	July 16 ..... Sept. 23, 24..... Oct. 26-Nov. 1, 14-24.	5.1	27.9

Heights of rivers above zeros of gages, 1899—Continued.

Stations.	Highest water. Stage.	Highest water. Date.	Lowest water. Stage.	Lowest water. Date.	Mean stage.	Annual range.
Tennessee River—Cont'd.	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Florence, Ala	25.2	Mar. 20	−0.1	Sept. 26, Oct. 10. Oct. 30-Nov. 6..	5.2	25.3
Riverton, Ala	40.0	Mar. 21, 22..	−2.0	Nov. 2, 3.....	7.1	42.0
Johnsonville, Tenn	39.7	Mar. 31	0.0	Oct. 11-13..... Nov. 3-7.....	9.0	39.7
Cumberland River.						
Burnside, Ky	57.5	Mar. 5	−0.7	Sept. 24, Oct. 7..	6.7	58.2
Carthage, Tenn	41.7	Feb. 8	−0.1	Sept. 13-15, 17, 18, Oct. 8.	8.4	41.8
Nashville, Tenn	40.8	Feb. 11	0.6	Sept. 16-27..... Oct. 2, 3, 6, 7, 9, 10.	11.1	40.2
Arkansas River.						
Wichita, Kans	6.3	June 10.....	1.3	Mar. 3.....	2.2	5.0
Webbers Falls, Ind. T	24.8	May 8.....	1.3	Oct. 13-15, 19-25.	4.7	23.5
Fort Smith, Ark	26.4	May 9.....	1.4	Oct. 10, 11.....	6.2	25.0
Dardanelle, Ark	23.5	May 10.....	0.9	Oct. 26, 27.....	6.0	22.6
Little Rock, Ark	24.5	May 11.....	2.3	Oct. 24-Nov. 1..	7.3	22.2
White River.						
Newport, Ark	28.0	May 13.....	0.7	Oct. 11, 12.....	7.4	27.3
Yazoo River.						
Yazoo City, Miss	25.8	Apr. 9-14....	−2.6	Oct. 11-28..... Nov. 14-24.....	8.6	28.4
Red River.						
Arthur City, Tex	28.6	Nov. 25.....	4.3	Jan. 4, 5, Mar. 7.	.....	24.3
Fulton, Ark	26.0	Nov. 27, 28..	2.5	Oct. 25-28.....	9.0	23.5
Shreveport, La	15.7	Jan. 25.....	−0.7	Oct. 30-Nov. 3..	6.3	16.4
Alexandria, La	18.9	Jan. 27.....	−2.6	Nov. 3..... ...	6.6	21.5
Ouachita River.						
Camden, Ark	39.1	Jan. 18.....	2.4	Oct. 14-20.....	9.4	36.7
Monroe, La	32.3	Feb. 5-7	0.0	Sept. 28-Nov. 27.	12.4	32.3
Atchafalaya River.						
Melville, La	33.4	Apr. 30 ..... May 1.	1.6	Nov. 6	20.0	31.8
Susquehanna River.						
Wilkesbarre, Pa	21.0	Jan. 7.....	−2.0	Aug. 22-27..... Sept. 19-24 ..... Oct. 5-Nov. 1...	2.9	23.0
Harrisburg, Pa	13.5	Mar. 7	0.2	Oct. 24-26	3.1	13.3
W. Br. of Susquehanna.						
Williamport, Pa	13.1	Mar. 6	0.0	Aug. 7, 8, 21.....	2.8	13.1
Potomac River.						
Harpers Ferry, W. Va	16.7	Mar. 6	0.2	Oct. 29-31	2.8	16.5
James River.						
Lynchburg, Va	19.0	Mar. 5	−0.1	Aug. 24-26.....	1.6	19.1
Richmond, Va	22.0	Feb. 18	−2.8	Sept. 29, Oct. 29. Nov. 12..... Dec. 13, 28	0.9	24.8
Cape Fear River.						
Fayetteville, N. C	42.0	Mar 17	1.4	Sept. 7, Oct. 5..	9.7	40.6
Lumber River.						
Fair Bluff, N. C	7.5	Feb. 15.....	0.1	Sept. 9, 10	3.8	7.4
Edisto River.						
Edisto, S. C	6.5	Feb. 13. ...	1.0	July 23	3.9	5.5
Pedee River.						
Cheraw, S. C	35.2	Feb. 8.....	0.7	Oct. 4, 5	6.6	34.5
Black River.						
Kingstree, S. C	11.6	Feb. 19-21 ..	0.5	Aug. 20-28.....	4.4	11.1
Lynch Creek.						
Effingham, S. C	17.2	Feb. 12.....	1.4	Aug. 26..... ...	6.0	15.8
Santee River.						
St. Stephens, S. C.	15.3	Feb. 15.....	−0.9	Oct. 7	5.5	16.2
Congaree River.						
Columbia, S. C.	21.3	Feb. 8	−0.3	July 15	1.9	21.6
Wateree River.						
Camden, S. C	31.0	Feb. 8	2.7	Oct. 4, 5, 25.....	8.5	28.3
Waccamaw River.						
Conway, S. C.	8.6	Mar. 1-3	1.2	Sept. 30-Oct. 2 .	3.9	7.4
Savannah River.						
Augusta, Ga	30.9	Feb. 8	3.9	Sept. 18	9.6	27.0
Broad River.						
Carlton, Ga	13.3	Mar. 16	1.9	Aug. 17-20, 22, 24 Sept. 24, 25, 29, 30 Oct. 1-4	3.0	11.4
Flint River.						
Albany, Ga	21.8	Feb. 15.....	−0.5	Sept. 28-30	4.8	22.3
Chattahoochee River.						
Westpoint, Ga	15.2	Feb. 28.....	1.1	Sept. 24	4.2	14.1
Coosa River.						
Rome, Ga	29.2	Mar. 17	0.3	Oct. 2-5 ..... Nov. 7-13.....	3.9	28.9
Gadsden, Ala	24.8	Mar. 21	−0.8	Sept. 29-Oct. 6 Nov. 12-15, 18-22	4.3	25.6
Alabama River.						
Montgomery, Ala	35.2	Mar. 2	−0.4	Oct. 2, 3	7.8	35.6
Selma, Ala	38.8	Mar. 3	−1.3	Oct. 2-4 ... . Nov. 16-18... ...	9.1	40.1
Tombigbee River.						
Columbus, Miss	31.4	Mar. 17	−3.8	Sept. 29, 30 ..... Oct. 11, 25, 26 ...	1.8	35.2
Demopolis, Ala	59.3	Mar. 24	−3.6	Oct. 12-16 ..... Nov. 10-21.....	12.5	62.9
Black Warrior River.						
Tuscaloosa, Ala	60.3	Mar. 17	−1.8	Oct. 3, 4	10.7	62.1
Columbia River.						
Umatilla, Oreg	25.2	June 21.....	−0.5	Jan. 5	8.7	25.7
The Dalles, Oreg	43.0	June 22.....	1.1	Jan. 9, 10	14.6	41.9
Willamette River.						
Albany, Oreg ...	23.0	Mar. 3	1.2	Oct. 14-16	6.2	21.8
Portland, Oreg	24.2	June 23.....	2.3	Oct. 14	9.9	21.9
Sacramento River.						
Redbluff, Cal	21.5	Mar. 25	−0.9	Aug. 25-Oct. 10.	2.6	22.4
Sacramento, Cal	24.2	Apr. 1, 2	7.4	Oct. 4-12.....	14.0	16.8

GENERAL CLIMATIC CONDITIONS.

By ALFRED J. HENRY, Chief of Division of Meteorological Records.

ATMOSPHERIC PRESSURE.

The numerical values of annual mean pressure for 1899 are given in Tables I and II. The method of reduction to sea level in use during the year was the same as in former years, with the exception that an appropriate correction for variations in the force of gravity with latitude has been applied since January 1, 1899. In other respects the annual mean values are comparable with those of the preceding and other years in which Professor Hazen's method of reduction was used.

In addition to the table of reduced pressures, referred to in the preceding paragraph, a second table has been formed (Table III), in conformity with the custom of previous years, by reducing the actual pressures to sea level and standard gravity in accordance with the tables and methods of the International Meteorological Committee, as explained in the MONTHLY WEATHER REVIEW for 1895, Volume XXIII, pages 492–494. The reduced pressures so obtained appear in Table III and on Chart I. The data in the last column of Table III are the pressures at 10,000 feet above sea level, obtained by assuming a uniform decrement of temperature at the rate of 2° F. per 1,000 feet (0.37° C. per 100 meters), as in former annual summaries; the resulting isobars are shown on Chart II.

The distribution of mean pressure at sea level for 1899 is shown by the isobars on Chart I. In general, the pressure distribution for the year 1899 differs but slightly from that of 1898. Pressure was generally above the normal east of the Mississippi River in both years. It was markedly above the normal over Nova Scotia and the Maritime Provinces of Canada in 1898 and also in 1899, although in a less degree. In the latter year the Atlantic high, as traced by the isobar of 30.05 mean annual pressure, extended several hundred miles farther to the northwestward than was the case in 1898. Pressure on the Pacific coast and Plateau region was slightly lower in 1899 than in 1898.

On the immediate Gulf coast of Louisiana, Mississippi and Alabama pressure was from .02 to .04 inch above normal in both years, while less than 200 miles inland, viz, at Vicksburg, Meridian, and Montgomery pressure was from .01 to .04 inch below normal. In both years pressure was also below normal from the Texas coast westward to Arizona and southern California. The rainfall of both years was likewise less than the normal amount. In mentioning these facts the writer does not intend to convey the impression that they stand in the relation of cause and effect. The fact that there was an average difference of 0.07 inch in pressure between Vicksburg and New Orleans, 0.04 between Mobile and Montgomery, and the same amount between Atlanta and Jacksonville would seem to suggest rather marked changes in the normal air motions along the Gulf coast.

In the Annual Summary for 1898 attention was called to a trough of low pressure which apparently paralleled the foothills of the Rocky Mountains in that year. A similar trough appears on the pressure chart for the current year and the precipitation generally throughout the axis of the trough was above normal as in 1898.

TEMPERATURE.

Although the year was characterized by some of the coldest weather experienced within the last twenty or thirty years, the average temperature on the whole was above normal.

During the greater part of January there were no severe cold waves, but, beginning with the first week in February, the most remarkable cold wave, or series of cold waves, in the history of the Weather Bureau traversed the United States from the north Pacific to the south Atlantic coasts, damaging crops and fruits in the Southern States to a very great extent. The lowest temperatures on record since the beginning of observations were recorded at a number of points in the North Pacific coast States during the first eight days of the month. From the 9th to the 12th of the month the coldest weather on record was reported at a number of points in the Central, Western, and Northwestern States. During the 13th and 14th a cold wave overspread the Southern and Eastern States attended on the 13th by the lowest temperatures ever recorded at many points in the Southern and Gulf States. March was a cold, wintry month, and the spring was generally backward with much snow and unseasonable weather east of the Rocky Mountains.

TABLE A.—*Average monthly and annual departures of temperature from the normal during* 1899.

Districts.	Number of stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	10	+0.5	− 2.7	0.0	+0.9	+0.2	+2.1	+0.3	−0.2	−0.8	+1.9	0.0	+2.6	+0.4
Middle Atlantic	12	0.0	− 6.6	+ 0.9	+1.0	+0.9	+1.8	0.0	+1.1	−0.9	+2.5	+ 1.6	+0.8	+0.3
South Atlantic	10	+0.2	− 5.5	+ 2.3	−2.4	+2.1	+1.5	−0.3	+2.2	0.0	+1.9	+ 2.2	−1.5	+0.2
Florida Peninsula	3	+2.0	− 1.2	+ 1.4	−2.3	+1.4	−0.1	−0.9	+0.7	+0.2	+0.7	+ 0.2	+0.2	+0.2
East Gulf	8	−0.8	− 9.3	+ 1.5	−2.4	+4.3	+1.1	+0.1	+2.0	−0.7	+2.5	+ 3.0	−1.8	0.0
West Gulf	7	+0.6	−10.4	+ 1.6	−2.0	+3.9	+0.3	0.0	+3.5	+0.3	+3.8	+ 3.2	−2.1	+0.2
Ohio Valley and Tennessee	11	+0.4	−10.6	− 0.2	+1.3	+3.4	+1.5	+0.5	+3.2	−0.1	+4.9	+ 4.5	−2.9	+0.5
Lower Lakes	8	+0.2	− 5.3	− 0.7	+4.2	+1.7	+1.2	+0.3	+2.2	−2.3	+4.9	+ 3.5	−0.2	+0.8
Upper Lakes	10	−0.5	− 6.3	− 5.0	+3.7	+2.1	+0.9	−0.6	+2.5	−2.8	+5.0	+ 8.0	−0.1	+0.6
North Dakota	3	+4.3	− 5.9	−13.6	−2.0	−1.8	−1.1	0.0	−0.2	+0.7	+0.1	+12.5	+0.3	−0.6
Upper Mississippi	11	+2.9	− 2.7	− 6.4	+1.2	+1.6	+1.1	−0.1	+3.1	−0.8	+6.1	+ 9.1	−1.7	+0.5
Missouri Valley	10	+5.0	− 2.8	− 8.3	−1.6	+2.1	+0.6	−0.5	+3.5	−0.2	+5.2	+ 9.4	−3.1	+0.2
Northern Slope	7	+4.2	−12.2	−10.6	−2.1	−2.5	−1.1	−0.5	−1.3	+2.9	−1.8	+ 8.5	−0.9	−1.4
Middle Slope	6	+3.0	−12.1	− 4.3	−0.2	+2.6	+0.4	−1.4	+4.0	+1.2	+3.6	+ 6.8	−2.6	+0.1
Southern Slope	2	+0.8	− 8.9	+ 2.0	−1.0	+1.6	−1.9	−1.8	+6.4	+1.7	+3.2	+ 4.2	−1.6	+0.4
Southern Plateau	5	+0.5	− 1.1	+ 0.1	+1.5	−3.1	−0.8	−0.2	−0.9	+3.9	−1.1	+ 2.5	+1.1	+0.2
Middle Plateau	3	+5.6	− 0.6	− 1.9	−0.2	−6.4	−0.4	+0.6	−5.6	+2.5	−3.5	+ 3.9	−2.9	−0.7
Northern Plateau	5	+6.3	− 4.0	− 1.3	−2.0	−5.5	−1.2	+1.2	−6.2	+4.5	−2.0	+ 7.9	−0.9	−0.3
North Pacific	8	+1.9	− 1.6	− 2.6	−1.6	−4.7	−2.6	+0.1	−2.9	+2.4	−0.8	+ 5.8	+1.5	−0.5
Middle Pacific	5	+2.8	0.0	− 1.1	+0.5	−3.5	+0.1	−1.0	−2.6	+1.2	−1.3	+ 1.9	−0.9	−0.3
South Pacific	4	+3.3	− 0.2	− 1.2	+0.2	−3.8	+0.2	−0.3	−3.1	+1.3	−1.9	+ 1.1	+0.9	−0.3

In Idaho, Montana, and Wyoming, the western portions of the Dakotas and Nebraska temperature was below normal for four consecutive months, viz, during February, March, April, and May, and also, but in a less degree, during the months of June, July, August, October, and December.

The summer was marked by an absence of periods of continued high temperature. Very nearly normal conditions prevailed in all parts of the country.

The fall of the year was generally mild and free from sharp and decided temperature changes.

Interlake navigation began about the first of May and ended about December 17. The weather in the closing months was quite free from severe storms.

The average monthly and annual departures of temperature from the normal during 1899 by geographic districts are shown in Table A.

PRECIPITATION.

The precipitation of the year just ended was not evenly distributed. There were seven separate regions, of greater or less extent, in which more than the normal quantity of rain and snow fell, viz: (1) The Pacific coast from central California to British Columbia, including part of the central and all of the northern Plateau; (2) eastern Wyoming and the Black Hills region of South Dakota; (3) eastern Colorado, Kansas, Oklahoma, and the panhandle of Texas; (4) northern Wisconsin and the Lake Superior region; (5) southeastern Iowa and central Illinois; (6) a narrow strip of country east of the Appalachians, extending from Augusta, Ga., to Washington, D. C.; (7) the western portion of the Peninsula of Florida.

Precipitation was markedly deficient in the lower Mississippi Valley, the deficits at the two regular Weather Bureau stations in Louisiana being 25 and 29 inches, respectively. The rainfall of the Gulf States in 1898 was almost normal, and it seemed at the end of that year that the droughty conditions which had prevailed for a number of years were about to come to an end. The year just closed, however, presents the same marked deficiency in precipitation throughout the Gulf States and Texas that has characterized so many years within the last decade. The cause of the deficiency is not, at present, known.

A drought of much greater importance, measured by its effect upon agricultural and industrial interests, prevailed throughout the region of the lower Lakes and the Middle and New England States. The fall of rain and snow on the headwaters of the streams in New England, along which so many manufacturing interests are centered, was not sufficient to give the normal summer flow in the streams, and a number of mills were obliged to shut down. In New York State numerous forest fires swept over the drought-stricken regions.

On the Pacific coast the precipitation of the last rain year, viz, September, 1898–May, 1899, was far below the normal amount. The present rain year began quite auspiciously, and there had fallen, up to December 31, considerably more than the normal amount of rain.

Table B gives the monthly departures of precipitation for each geographic district.

TABLE B.—*Monthly and annual departures of precipitation from the normal during* 1899.

Districts.	Number of stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	10	−0.1	+0.2	+2.9	−1.4	−1.8	−0.5	+0.2	−2.0	+0.7	−1.8	−1.9	−1.8	− 7.3
Middle Atlantic	12	−0.4	+1.8	+1.3	−1.9	−1.3	−1.0	0.0	−0.4	+0.4	−0.6	−1.6	−1.7	− 5.6
South Atlantic	10	−0.2	+2.7	−1.4	−0.3	−1.6	−1.8	+0.3	0.0	−3.1	+0.8	−1.2	−1.4	− 7.2
Florida Peninsula	3	+2.3	+2.3	−0.4	+0.8	−3.0	0.0	+1.4	−1.5	−0.1	+2.3	−1.8	0.0	+ 2.3
East Gulf	7	+0.2	−0.4	−1.6	−2.4	−2.8	−0.8	+1.0	+0.2	−3.0	−1.0	−1.1	+0.7	−11.0
West Gulf	7	+1.1	−1.6	−2.0	−1.0	−0.9	+0.3	+0.8	−2.5	−2.7	+0.6	−1.3	+0.5	− 8.7
Ohio Valley and Tennessee	11	+0.1	−0.7	+2.5	−1.6	−0.5	−1.5	−0.6	−0.8	−1.0	−0.5	−1.5	−0.1	− 6.2
Lower Lakes	8	−0.3	−0.8	+1.2	−1.2	+0.5	−1.8	−0.4	−2.1	−0.2	−0.9	−1.6	+0.7	− 6.9
Upper Lakes	10	−0.8	−1.0	+0.1	−0.5	+0.3	+0.2	+0.5	−0.9	−0.2	−0.5	−1.6	+0.1	− 4.3
North Dakota	3	−0.2	−0.3	+0.2	−0.9	+1.3	+0.3	−1.2	−0.4	−0.8	−0.3	−0.4	0.0	− 2.7
Upper Mississippi	11	−0.6	−0.2	+0.2	−0.7	+2.5	+0.2	−0.2	+0.5	−1.3	−0.3	−0.8	−0.1	− 0.8
Missouri Valley	10	−0.6	−0.4	−1.0	−1.0	+0.2	+0.1	−1.2	−0.7	−1.4	0.0	−0.5	0.0	− 5.6
Northern Slope	7	+0.1	+0.1	+0.5	−0.8	+1.1	−1.0	−0.1	0.0	−0.6	+0.4	−0.1	+0.2	− 0.2
Middle Slope	6	−0.5	−0.3	−0.3	−0.7	+0.2	+2.0	+1.8	−0.8	0.0	+1.5	+1.0	+0.3	+ 4.2
Southern Slope	2	−0.4	−1.3	−0.7	−0.2	+0.8	+1.7	+2.2	−2.6	+1.0	+0.2	+2.0	+1.0	+ 3.7
Southern Plateau	5	−0.3	−0.5	−0.4	−0.1	−0.4	+0.3	+0.5	−0.7	−0.2	−0.4	+0.1	−0.8	− 2.9
Middle Plateau	3	−0.3	0.0	+1.1	−0.7	+0.3	−0.1	−0.1	+0.3	−0.5	+0.5	−0.3	−0.9	− 0.7
Northern Plateau	5	−0.1	0.0	−0.4	−0.1	−0.1	−0.8	−0.3	+0.8	−0.2	+1.3	+0.8	−0.4	+ 0.5
North Pacific	8	+3.0	+1.8	−1.8	+1.0	+1.1	−0.9	−0.7	+1.7	−1.7	+1.4	+6.2	0.0	+11.1
Middle Pacific	5	+0.5	−3.0	+2.7	−1.6	−0.4	−0.1	0.0	+0.2	−0.4	+2.4	+3.3	−1.6	+ 2.0
South Pacific	4	+0.4	−2.5	+1.0	−0.8	−0.3	+0.5	0.0	0.0	−0.1	+1.3	0.0	−1.2	− 1.7

METEOROLOGY OF THE GREAT LAKES.

The season of navigation was remarkably free from severe storms. April and May, in which months at least one severe storm is expected, passed without any unusual atmospheric disturbance. Likewise October and November, generally considered the most dangerous months of the season, brought no storms of sufficient violence to seriously interfere with navigation for any length of time. The most severe storm of the season occurred on December 11 and 12 at a time, however, when a large number of vessels had gone out of commission.

The rainfall in the Lake Superior basin was above normal. The snowfall of the winter and spring months was rather heavy not only in the Superior basin but also on the northern shore of Lake Huron, particularly in the Georgian Bay region. On the other hand, precipitation was generally below normal in the basins of Lakes Erie and Michigan, and also over those portions of the watersheds of Lakes Huron and Ontario, lying within the boundaries of the United States.

There was less fog reported during the season of 1899 than during the previous season. The most fog was observed over the central portion of Lake Superior.

A large amount of ice formed on the lakes during the winter of 1898–99, but winter navigation on Lake Michigan was not suspended except during the severe cold in the early part of February.

THUNDERSTORMS.

The frequency of thunderstorm days in the different months and in the several States and Territories is shown approximately by the figures of Tables V and VI. The first-named table has been prepared from reports of both regular and voluntary observers with a view of showing the number of thunderstorm days recorded each month in the immediate neighborhood of the respective stations. The second table shows the number of days on which thunderstorms were recorded in the State or Territory as a whole. In preparing the last-named table reports from all stations whatsoever were used. The number of thunderstorm days for a given State, as shown in Table VI, depends largely upon the size of the State and the number and distribution of observing stations. In the District of Columbia, for example, with but one station, the number of thunderstorm days was 45, while for the adjacent State of Maryland, with an average of 58 stations, thunderstorms were observed on 126 days. In Virginia, with about 54 stations, the number of thunderstorm days was 116. The number of thunderstorms observed at a single station bears a fairly definite relation to the number that would be observed were it possible to greatly enlarge the field of observation. The ratio for Washington, D. C., is about 2.7, that is to say, in order to ascertain the number of thunderstorm days for a region equal in area to the adjoining States of Maryland and Virginia we have only to multiply the number observed at Washington by the constant 2.7.

The greatest number of thunderstorms occurs in the south Atlantic and Gulf States and the Mississippi Valley. The number diminishes toward the northward and westward, although there seems to be a second region of maximum frequency along the eastern foothills of the Rocky Mountains in Colorado, Wyoming, and northern New Mexico. West of the Rockies, except possibly in Idaho, the number diminishes to less than 20 per annum. In California, Oregon, and Washington, they rarely occur on the immediate coast, but are not infrequent in the interior valleys and mountains back of the coast range. In Arizona they are most frequent in July and August, the rainy season in the mountainous part of that Territory.

There seem to have been more thunderstorms in 1899 than in the preceding year, although the difference is not very great. The greatest increase in the number of thunderstorms in 1899, as compared with 1898, occurred in the States of Florida, Michigan, Wisconsin, Minnesota, Iowa, and Nebraska. In a number of States, particularly those bordering on the Gulf of Mexico, there were fewer thunderstorms in 1899 than in 1898.

TABLE C.—*Monthly and annual departures of relative humidity from the normal*, 1899.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	− 2	+ 1	+ 4	− 4	− 4	− 6	0	0	− 4	+ 2	− 2	0	− 1.2
Middle Atlantic	0	+ 5	+ 6	+ 1	0	− 2	+ 3	+ 3	− 1	+ 6	+ 1	− 2	+ 1.7
South Atlantic	+ 2	+ 2	+ 1	+ 1	+ 1	− 3	− 2	− 2	− 3	+ 5	+ 1	− 7	− 0.3
Florida Peninsula	+ 2	+ 1	0	− 1	− 2	− 3	0	− 2	− 1	0	− 3	− 3	− 1.0
East Gulf	0	+ 3	− 1	+ 3	0	− 3	− 3	+ 1	− 6	+ 2	− 5	− 5	− 1.2
West Gulf	+ 1	+ 3	− 1	+ 1	+ 6	+ 2	+ 2	− 3	− 9	+ 1	+ 2	0	+ 0.4
Ohio Valley and Tennessee	0	+ 3	+ 5	+ 1	+ 1	− 1	− 1	− 1	− 6	0	+ 3	− 2	+ 0.2
Lower Lakes	− 6	− 5	+ 3	− 3	− 1	− 5	+ 2	− 3	− 4	+ 2	+ 2	− 2	− 1.7
Upper Lakes	+ 2	+ 2	+ 4	+ 2	+ 3	0	+ 6	+ 3	+ 2	+ 3	+ 3	+ 1	+ 2.6
North Dakota	− 6	− 4	+ 3	+ 2	+ 3	+ 4	0	+ 5	− 1	+ 8	0	+ 2	+ 1.3
Upper Mississippi	− 2	− 1	+ 6	+ 2	+ 3	− 1	0	+ 1	− 4	0	+ 3	+ 1	+ 0.7
Missouri Valley	− 8	− 5	+ 5	+ 1	+ 5	+ 3	0	+ 1	− 8	+ 1	+ 2	0	− 0.2
Northern Slope	− 3	+ 8	+ 8	+ 1	+ 4	− 1	+ 2	+ 5	+ 1	+10	+ 2	+ 8	+ 3.8
Middle Slope	0	+ 6	+ 6	− 1	− 3	+ 2	+ 7	− 5	− 4	0	+ 4	+ 7	+ 1.6
Southern Slope	+ 2	− 5	−10	− 1	+ 4	+ 6	+10	−19	− 5	0	+13	+ 6	+ 0.1
Southern Plateau	− 4	−12	−12	− 3	−10	+ 5	− 1	−12	−13	−10	− 2	− 7	− 6.8
Middle Plateau	− 1	+ 2	+ 4	− 2	− 3	− 4	− 2	+ 5	− 9	+ 3	+ 2	+ 3	− 0.2
Northern Plateau	− 2	− 3	0	− 2	+ 2	0	− 3	+ 9	− 3	+ 5	+ 2	0	+ 0.4
North Pacific	+ 2	0	− 4	− 4	+ 1	− 5	− 5	+ 1	− 3	− 3	0	− 2	− 1.9
Middle Pacific	− 5	−11	0	− 7	− 6	− 5	− 9	− 5	−12	− 4	+12	0	− 4.3
South Pacific	− 6	−10	− 5	+ 2	+ 1	+ 5	+ 1	+ 4	+ 2	+ 1	+11	− 3	+ 0.2

TABLE D.—*Monthly and annual departures of average cloudiness from the normal*, 1899.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	−0.5	+0.4	+1.1	−1.3	−0.1	0.0	+0.1	+0.5	−0.1	+0.9	+0.3	−0.3	+0.1
Middle Atlantic	−0.1	+0.5	+1.2	−0.7	+0.1	−0.3	+0.3	+0.6	−0.8	+0.2	−0.4	−0.5	0.0
South Atlantic	+0.7	+0.5	+0.1	+0.6	0.0	−0.7	+0.5	−0.1	−1.3	+1.1	−0.6	−0.2	0.0
Florida Peninsula	−1.0	+0.2	−0.9	+0.3	−1.0	−0.6	+0.8	−0.2	+0.2	+0.8	+0.1	+0.7	0.0
East Gulf	+0.7	+0.7	−0.2	0.0	−0.9	−0.7	−0.5	−0.6	−1.7	+0.8	+0.1	+0.5	−0.2
West Gulf	+0.2	−0.2	−0.1	+0.4	+1.1	+0.4	+0.2	−2.0	−1.4	+0.7	0.0	−0.1	−0.1
Ohio Valley and Tennessee	0.0	+0.1	+1.0	+0.1	+0.7	−0.8	+0.1	−0.4	−0.6	0.0	+0.3	−0.3	0.0
Lower Lakes	−0.4	+0.2	+1.4	−0.5	+0.6	−1.1	+0.1	−1.0	+1.2	−0.7	+0.4	0.0	0.0
Upper Lakes	−0.6	−0.5	+1.0	−0.3	+0.1	−0.2	+0.4	−0.2	+0.9	−0.1	−0.1	−0.4	0.0
North Dakota	+0.2	−0.8	−0.1	−1.0	+0.7	−0.8	−1.0	−0.1	−0.8	+0.9	−1.3	−0.4	−0.4
Upper Mississippi Valley	−0.1	0.0	+1.2	−0.2	+0.9	−0.4	+0.1	+0.3	−0.3	−0.2	+0.5	−0.5	+0.1
Missouri Valley	−0.3	−0.4	+0.6	−0.2	+0.7	−0.1	+0.4	+0.1	−0.5	+0.1	+0.5	+0.5	+0.1
Northern Slope	+1.1	+1.0	+0.8	−0.4	+0.6	−0.1	+0.4	+0.5	−0.6	+1.3	−0.2	+1.2	+0.5
Middle Slope	+0.8	0.0	+0.6	−0.2	−0.4	+0.5	+0.8	−1.0	−0.4	+0.5	+1.0	+0.9	+0.3
Southern Slope	+0.2	−0.9	−1.1	+0.9	−0.3	−0.4	+0.6	−3.6	−1.6	+0.1	+1.0	+0.8	−0.4
Southern Plateau	−0.7	−0.8	−0.6	+0.5	+0.7	+0.3	0.0	−1.2	−0.7	+0.5	+0.3	+0.4	−0.1
Middle Plateau	−1.6	+0.4	+1.7	+0.4	+1.8	−0.4	+1.1	+1.2	−0.7	+1.7	+1.3	+0.4	+0.6
Northern Plateau	+0.9	−0.2	−0.3	−0.4	+0.5	−0.8	−0.4	+1.6	−1.3	+1.2	+1.0	0.0	+0.1
North Pacific	+1.6	+1.0	+0.1	+0.5	+2.0	−0 1	−0.4	+2.8	−0.9	+0.8	+1.9	+0.6	+0.8
Middle Pacific	+1.2	−0.7	+1.5	−0.4	−0.2	−1.2	+0.6	+1.0	−0.1	+1.0	+3.0	+0.2	+0.5
South Pacific	−0.1	−1.7	−0.1	−0.5	−0.7	+0.1	−0.6	−0.1	−0.5	+0.5	+2.4	+0.2	−0.1

SPECIAL CONTRIBUTIONS.

REMARKABLE AURORA AT BRAIDENTOWN, FLA., NOVEMBER 18, 1899.

By H. TEN BROECK.

There was a display of the aurora borealis, November 18, of extraordinary brilliancy, considering the low latitude of this place, N. 27° 30′, W. 82° 30′. It was 11:30, local time, when I first saw it. There was a bright arch due north very irregular and undefined in outline, about 20° high. It was white with a yellowish tinge, from it issued lambent streamers, reaching beyond the zenith and extending from the eastern to the western horizon, merging into a haze on the horizon—the effect of perspective probably. The streamers were pale white with an occasional light red tint. In about fifteen minutes they extended to the southern horizon merging into a haze. They were very straight and regular in form, varying in brightness constantly, though slowly. The arch in the north also varied some in brightness and changed to a slight rosy tint now and then. A halo formed around the moon, about 35° in diameter and 4° or 5° broad, but with no dark circle within; there was also a small halo around the moon touching it, and having bands of faint blue and yellow colors. The sky was clear, except a small cirrus cloud in the south, air calm, thermometer 66°. By midnight the meteor had faded greatly, and by 12:30 had almost entirely disappeared and made no further appearance. Even in the light of the full moon it was extraordinarily bright, and in the absence of the moon it would have been, of course, far more so and of a brightness above the common in such displays. I never saw such a bright one even when living for thirty-nine years in latitude 40° to 45°. One small meteor appeared in the northeast going northwest with a track of about 20°, while the aurora was at its brightest.

SMALL SEISMIC CHANGES CAUSED BY BUILDING OPERATIONS.

By C. F. MARVIN, Professor of Meteorology, dated December 15, 1899.

Mr. H. H. Kimball, of the Instrument Division, reports a marked effect upon the Weather Bureau seismograph resulting from building operations in progress for some months past on the Weather Bureau property. The following is a brief statement of the circumstances and results.

About the first of July last, building operations were begun on additions to the so-called annex to the main Weather Bureau building, and on a row of two-story brick storerooms near to, but not adjoining the main building. The work is now practically completed.

The seismograph is installed as formerly in a small basement room of the main building, within about 18 inches of the south wall, and about one-fifth the length of the building from the southwest corner. The registration of effects is produced electrically; the register being located in a room in the annex. The row of brick storerooms extends parallel to the south and west walls of the main building, with a roadway about 10 feet wide separating the two.

The main building is erected upon a terrace of ground, ranging from 12 to 18 feet above the level of the adjacent streets and pavements. Originally, the floor of the basement room containing the instrument was about 6 feet below grade, but the 10-foot roadway and the space occupied by the storerooms were cut down and graded to about the same level as the basement floor of the main building. These operations exposed the south and west foundation walls of the old building in several places.

The soil consists of a fine, hard, clay, resting upon a granite formation 10 to 20 feet lower down. A portion of this granite had to be removed in the deeper excavations for the new engine room, about 200 feet to the northeast. Notwithstanding that a number of blasts were fired to break out the rock, these do not appear, in any case, to have disturbed the instrument sufficiently to produce a record. The charges, however, were necessarily very small, owing to the immediate proximity of the printing and boiler rooms adjoining, which circumstance, together with the distance of the focus from the seismoscope and the probable rapid rate of oscillation of the earth particles seem to sufficiently explain the results.

The excavation of the roadway exposed and extended below the foundation wall of the *southeast corner* of the main building, and it was necessary to underpin this wall and carry the foundation down to the proper depth. The grading and excavation were practically completed, and the brickwork on the storerooms was far advanced before the corner wall was underpinned.

As the work of excavation advanced the seismic apparatus recorded a large number of disturbances from September 20 to September 24. The latter date falling on Sunday. From 4:45 a. m. to 10 a. m. the circuit remained permanently closed, showing that apparently the floor of the room had tilted slightly.

About this date the underground cable connection between the Instrument Room and the seismoscope was interrupted by the excavations and not finally restored until October 20. In readjusting the instrument it was found the level of the floor had permanently changed, the south edge being depressed.

After the instrument was again readjusted on October 20 no further disturbance was recorded until November 16, at which time the work of underpinning the southeast corner wall was in progress. The instrument was more or less continuously disturbed for about an hour, whereupon the circuit became permanently closed at about 10:30 a. m., showing again a pronounced subsidence of the south edge of the floor. The instrument being again adjusted, recorded no further disturbance until December 8. This record on this date accompanied the removal of a flight of outside stone steps leading down to the basement from the old grade level. A bench of earth in a small recess of the wall of the main building, immediately outside the seismoscope room, was also removed at this time, the instrument in this case showing a subsidence of the east edge of the floor.

The small alterations of level thus recorded by the seismograph have not produced the slightest visible effect on the walls of the main building, and it is not considered that these have in any way suffered injury.

From the known dimensions of the seismograph it is roughly estimated that an angular tilting of its foundation of about five minutes of arc will suffice to permanently close the electric circuits and produce the results noted. During the seven years the instrument has been in use no permanent change of level such as noted above was ever observed.

NOTES ON THE CLIMATE OF MISSOURI.

By ARTHUR E. HACKETT, Section Director, Columbia, Mo., dated January 30, 1900.

The annual mean temperature of Missouri, as computed from all available records to the end of 1898, is 54.5°. The annual mean of each of the five physiographical divisions of the State is as follows: Northwestern plateau, 51.9°; northeastern plain, 53.6°; southwestern lowlands, 54.5°; Ozark plateau, 55.2°; and southeastern lowlands, 57.6°. The lowest annual mean temperature is found in the extreme northwestern counties, where it is slightly below 50°, and the highest in the extreme southeastern counties, where it is about

60°. The variations in the annual mean temperature from year to year rarely exceed 3°, and are often less than 1°. The following table shows the mean temperature of each division by seasons:

Divisions.	Spring.	Summer.	Autumn.	Winter.
	°	°	°	°
Northwestern plateau	27.7	51.8	74.5	53.6
Northeastern plain	30.6	53.5	75.3	55.1
Southwestern lowlands	31.9	54.3	75.7	56.1
Ozark plateau	34.7	55.1	74.8	56.2
Southeastern lowlands	37.3	58.0	76.7	58.3
State	32.4	54.5	75.3	55.9

The warmest month of the year is July, with a mean temperature for the State of 77°, and the coldest is January, with a mean temperature of 29.8°. During the months of June, July, August, and September the temperature occasionally rises to 95°, but does not often exceed 100°. During the winter months the temperature sometimes falls to 5° or 10° below zero, but temperatures of 20° below zero are of rare occurrence. The average number of days during the year with maximum temperature above 90° is 20, and the average number with minimum temperature below 32° ranges from about 75 in the southern to 110 in the northern portion of the State. During the winter cold waves occasionally sweep over the State which cause falls in the temperature of from 40° to 60° in twenty-four hours, but periods of extreme cold are usually of short duration, as are also periods of extreme heat in summer.

The average date of the last killing frost in spring and the first in autumn, as computed from the records of the several Weather Bureau stations, is as follows:

Station.	Last in spring.	First in autumn.	Length of season.
			Days.
Keokuk, Iowa	April 11	October 13	184
Hannibal, Mo	April 13	October 16	185
St. Louis, Mo	April 10	October 31	203
Columbia, Mo	April 13	October 14	183
Kansas City, Mo	April 8	October 16	190
Springfield, Mo	April 16	October 13	180
Cairo, Ill	March 29	October 25	209

The average annual precipitation for each division and for the State, compared from all records to the end of 1898, is as follows: Northwestern plateau, 36.33 inches; northeastern plain, 38.41 inches; southwestern lowlands, 39.24 inches; Ozark plateau, 43.73 inches; southeastern lowlands, 46.36 inches; and for the State, 40.81 inches. The wettest months are May and June, the average precipitation for the State for those months being 5.23 and 4.95 inches, respectively, and the driest are February and October, with an average for the State of 2.33 and 2.36 inches, respectively. The following table shows the average precipitation for each division by seasons:

Division.	Spring.	Summer.	Autumn.	Winter.
	Inches.	*Inches.*	*Inches.*	*Inches.*
Northwestern plateau	10.74	13.62	7.32	4.65
Northeastern plain	11.58	11.87	8.45	6.51
Southwestern lowlands	12.44	12.59	7.79	6.42
Ozark plateau	14.00	12.75	8.89	8.09
Southeastern lowlands	14.53	11.36	9.90	10.57
State	12.65	12.44	8.47	7.25

Of the years from 1888 to 1899, inclusive, the wettest was 1898, with an average for the State of 53.67 inches, and the driest was 1894, with an average of 33.18 inches. Rainfalls of from 2 to 3 inches in twenty-four consecutive hours occur in some portion of the State during nearly every month of the year, but falls of more than 4 inches in twenty-four hours are comparatively rare.

From November to March, inclusive, the precipitation is usually general in character, but during the summer months the greater part occurs in the form of local showers.

The average seasonal snowfall ranges from about 10 inches in the southeastern to about 25 inches in the northwestern portion of the State.

The prevailing winds are southerly, although during the winter season northwesterly winds prevail a considerable part of the time. The average hourly wind velocity ranges from 5 to 10 miles during the summer, and from 8 to 12 miles during the winter months.

The average cloudiness ranges from 35 to 50 per cent during the summer and autumn, and from 50 to 55 per cent during the winter and spring. The average number of rainy days (days on which .01 of an inch or more of precipitation falls) is 9 in January and February, 10 in March, 11 in April, 13 in May, 11 in June, 9 in July, 8 in August and September, 7 in October, and 8 in November and December.

The mean annual relative humidity is 72 per cent.

CLIMATOLOGY OF ST. KITTS.

By WILLIAM H. ALEXANDER, Observer, Weather Bureau, dated November, 29, 1899.

Discovered by and named for the peerless prince of mariners, the little island of St. Christopher, or as more generally known St. Kitts, first appears on the pages of written history in 1493, possessed of a charm which becomes more and more intense as we follow its varied history through subsequent years. Believing that this history could be made to pay rich tribute to the subject of meteorology, the writer began and is diligently pursuing an investigation of all available records of whatever character which might throw some light upon any phase of this subject. The present memoir gives some of the results of these labors.

Because of the intimate relation between the topography of any place and many phases of its meteorological history, a clear understanding of its topography is highly important, consequently I begin this discussion with a few words on this point.

The island lies in north latitude 17° 20′ and west longitude 65° 45′. The area of the main body resembles a long oval from the southeastern end of which runs a narrow neck, gradually expanding into a small knob. The total length of the island is 23 miles, and the breadth of the main body is about 5 miles; that of the knob or peninsula, about 2 miles. The breadth of the neck varies from half a mile to a mile. The total area of the island is 68 square miles.

The central part of the main body is occupied by a range of lofty, rugged mountains which traverses it from southeast to northwest, attaining its greatest height at Mount Misery, with a secondary culminating point near the southeastern end of the island, and between these two there is a decided depression. Mount Misery is about 4,100 feet high, and the secondary elevation about 3,200 feet. The mountains appear to be crowded together and are intersected by rocky precipices. From the secondary culmination a range of hills branches off describing almost a semi-circle, and forming the spacious and fertile valley or plane in which Basseterre is situated. Immediately beyond the hills on the southeast is the narrowest part of the neck, which at this point is perfectly flat, but as it expands it rises into conical hills which traverse the knob or peninsula in almost every direction. In one spot, however, the hills recede from the sea, forming a basin within which is a salt pond about 2 miles in circumference.

The circle of land formed by the skirts and lower slopes of the mountains of the main body of the island and the valley of Basseterre, constitute nearly the whole of the arable

and cultivated portion of the island. These tracts of land are covered with sugar plantations and dotted over in every direction with homesteads, mills, and laborers' villages. The higher slopes of the mountains are clothed with short grass affording excellent pasturage, while their summits are crowned with dense woods.

That the island is of igneous origin is established beyond question by the immense layers of volcanic ashes found in every section. At Sandy Point, for instance, there are alternate layers of these ashes and soil for a depth of 75 feet on a substratum of gravel. The soil is a dark grey loam, very porous, and is considered the very best compost in the West Indies for the production of sugar. Clay is found in considerable quantities in the high or mountain lands, while the low lands are quite deficient in it.

The climate, speaking in a general way, is about what one might reasonably expect of a tropical island of the size and elevation of St. Kitts—dry and healthful, tempered and purified by the electric storms and hurricanes to which it is subject because of its position. The bracing qualities of the atmosphere are portrayed in the general good health of the inhabitants. The mornings and evenings of the hottest days are agreeably cool. The coldest months are January and February, the warmest, August.

Referring to the instruments used in securing the tabulated data herewith, it ought, perhaps, to be stated that the barometer was a standard mercurial, and the thermometer one of the best obtainable at the time. As to whether or not any corrections were made in the readings of the barometer from 1856 to 1882, inclusive, nothing is known; nor can the exposure of the thermometer be given; but the readings from 1892 to 1899 were reduced to sea level. It is believed that all the thermometer readings are too high, due to imperfect exposure, but granting that the instruments were not up to the requirements of to-day and that the exposure was not according to prescribed regulations, yet it must be admitted that there is a value in the data not to be despised. The records from 1856 to 1882, inclusive, were taken from the same instruments and by the same person; those from 1892 to August, 1898, were from the same set of instruments and by the same observer; while those from September, 1898, to October, 1899, are from the United States Weather Bureau instruments. The data must, therefore have a comparative value worthy of the consideration.

Barometric pressures.—The data contained in Table 1, covering a period of thirty-four years and ten months, gives as the normal barometric mean for the year, 29.97 inches. By reference to figs. 1 and 2 it may be readily seen how slight are the departures and how small the range of the monthly means from this normal under usual conditions. The average range of the barometric pressure for the year is only .086 inch. Fig. 2 shows that the greatest departure above the normal occurs in February and June, and the greatest departure below the normal occurs in October and November, while the barometric conditions are most nearly normal in May, August, and December. That a slight or sudden disturbance beyond the narrow limits of the normal in the barometric gradients portend disastrous consequences is a well recognized fact, and the vigilance with which the people here watch "the glass" is not surprising.

TABLE 1.—*Showing the average monthly barometric pressure and temperature for a period of thirty-five years and total rainfall for each month for a period of forty-four years at Basseterre, St. Kitts, W. I.*

Year.	January.			February.			March.			April.			May.			June.		
	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.
	Ins.	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*
1856	30.03	81.0	2.40	30.02	80.7	2.40	30.03	81.1	4.70	30.01	81.9	4.60	30.01	83.4	1.85	30.03	83.5	4.40
1857	30.03	77.5	3.65	29.98	76.7	3.55	30.01	77.7	2.45	29.98	79.6	3.15	29.98	78.4	5.90	30.01	81.2	4.60
1858	30.02	78.3	1.90	30.03	80.2	1.90	30.00	79.8	2.90	30.00	79.7	4.30	30.00	80.6	3.50	30.02	81.1	4.90
1859	30.02	76.5	3.90	30.04	76.0	3.80	30.03	77.4	0.20	30.02	79.7	2.70	29.97	80.8	5.40	30.02	81.0	2.90
1860	30.04	80.0	2.10	30.04	79.1	1.30	29.99	80.0	3.80	29.98	81.3	3.20	30.01	82.1	0.70	30.01	83.8	3.40
1861	30.01	77.4	2.90	29.99	78.3	2.00	29.97	78.5	2.15	29.95	78.9	15.10	29.96	80.4	4.50	30.00	80.7	6.50
1862	29.98	78.0	1.15	30.03	76.8	2.15	30.01	78.2	1.20	29.98	79.0	4.60	29.97	81.0	5.40	29.99	81.5	2.40
1863	29.98	76.2	2.10	30.04	76.1	1.50	29.99	77.9	1.10	29.97	78.3	2.45	30.01	80.8	2.30	30.04	81.3	2.15
1864	30.03	78.1	3.10	30.01	76.1	0.50	29.98	77.8	2.10	29.99	80.1	0.45	29.93	80.4	1.30	30.03	81.7	3.15
1865	30.01	80.4	2.80	30.00	79.3	1.45	30.02	78.1	0.50	30.02	80.8	1.20	29.99	82.4	6.80	30.03	82.7	7.80
1866	30.02	77.0	5.95	30.02	77.1	1.60	29.98	77.0	2.90	29.99	78.8	3.25	29.98	81.0	6.00	30.02	82.1	4.90
1867	30.01	77.1	1.75	30.01	76.2	1.95	29.99	78.0	1.90	29.92	79.6	2.30	29.92	81.8	8.10	29.98	82.2	6.35
1868	30.01	79.4	3.45	29.97	79.3	1.10	29.96	79.1	3.60	30.02	80.1	0.65	29.96	81.2	1.15	30.00	84.0	0.80
1869	30.00	79.2	1.40	29.99	79.1	0.45	29.98	78.5	1.75	29.97	81.7	0.70	29.96	83.3	1.50	30 00	83.9	3.40
1870	29.97	77.9	3.50	29.97	79.2	1.60	29.94	79.2	2.85	29.95	79.8	2.95	29.96	82.0	2.60	29.94	81.8	5.75
1871	29.93	78.1	5.75	29.94	78.4	2.45	29.96	78.4	2.10	29.90	80.7	7.10	29.94	81.8	2.80	29.98	83.3	1.65
1872	29.95	80.0	1.00	29.95	78.9	2.30	29.94	80.4	1.05	29.92	81.4	1.45	29.94	83.3	1.15	29.98	83.0	1.65
1873	29.96	77.9	6.90	30.00	78.0	0.80	29.98	78.4	4.20	29.98	80.5	2.70	29.96	81.7	3.40	30.00	83.0	0.90
1874	29.95	78.7	1.90	29.94	78.6	2.45	29.95	79.7	2.90	29.98	79.3	2.05	29.93	81.9	2.40	29.98	83.8	1.95
1875	30.00	78.7	2.95	30.03	78.0	1.20	29.99	78.7	2.95	29.97	78.8	0.40	29.97	80.2	0.75	30.00	82.4	1.60
1876	29.96	78.3	2.65	29.97	78.4	2.10	29.95	77.8	2.30	29.93	80.1	10.45	29.93	81.3	8.80	29.98	83.4	4.05
1877	30.01	80.0	2.30	29.95	79.1	2.45	29.96	83.1	1.45	29.92	82.4	6.05	29.92	84.1	0.65	29.97	83.6	9.00
1878	29.99	80.3	8.50	29.98	82.0	5.00	29.98	81.7	2.60	29.93	82.5	4.15	29.97	84.1	10.95	30.01	82.1	3.30
1879	30.01	79.4	3.80	29.99	81.0	2.45	29.97	80.9	3.50	29.97	82.0	10.20	29.92	82.7	7.80	29.98	83.7	4.80
1880	29.92	78.0	37.05	30.01	78.2	0.50	30.02	79.4	1.90	30.03	79.9	4.30	29.99	81.5	4.10	30.03	84.7	1.65
1881	29.99	80.3	2.10	29.95	79.2	1.05	29.97	81.6	0.25	30.01	83.7	1.15	29.93	83.7	8.30	30.00	85.2	7.65
1882	30.03	79.6	0.70	30.05	79.3	1.00	30.03	80.3	0.55	30.00	82.2	0.00	30.00	83.2	0.60	30.03	85.1	2.85
1883	.....	.....	3.25	.....	.....	4.75	.....	.....	1.80	.....	.....	5.85	.....	.....	4.48	.....	.....	4.65
1884	.....	.....	1.64	.....	.....	2.18	.....	.....	3.81	.....	.....	0.51	.....	.....	5.54	.....	.....	3.69
1885	.....	.....	2.44	.....	.....	1.19	.....	.....	2.77	.....	.....	2.14	.....	.....	1.09	.....	.....	3.37
1886	.....	.....	3.95	.....	.....	1.62	.....	.....	3.65	.....	.....	3.40	.....	.....	1.57	.....	.....	2.60
1887	.....	.....	1.52	.....	.....	0.46	.....	.....	0.91	.....	.....	0.60	.....	.....	7.10	.....	.....	7.25
1888	.....	.....	2.19	.....	.....	1.21	.....	.....	0.52	.....	.....	2.89	.....	.....	6.70	.....	.....	5.36
1889	.....	.....	1.35	.....	.....	4.25	.....	.....	2.46	.....	.....	8.85	.....	.....	7.74	.....	.....	9.02
1890	.....	.....	5.47	.....	.....	1.29	.....	.....	1.82	.....	.....	3.07	.....	.....	2.59	.....	.....	0.89
1891	.....	.....	3.21	.....	.....	1.41	.....	.....	0.01	.....	.....	1.21	.....	.....	1.38	.....	.....	2.38
1892	30.01	79.2	2.99	30.01	78.5	1.59	30.02	80.0	1.37	30.04	80.0	1.35	30.03	81.2	3.61	30.07	84.3	3.55
1893	29.98	80.0	0.49	30.01	77.3	3.03	30.00	77.2	0.95	30.00	78.3	2.59	28.97	79.9	6.57	30.00	81.1	3.61
1894	29 97	76.4	2.37	30.03	76.7	1.68	30.01	76.4	1.89	29.97	78.2	2.32	29.94	81.1	1.03	30.02	81.7	3.48
1895	29.97	76.7	3.53	29.98	77.4	1.53	30.00	78.7	0.77	29.99	82.1	0.81	29.99	79.4	10.77	30.03	82.3	2.66
1896	29.96	77.6	2.96	29.98	77.6	2.39	29.96	77.9	2.57	29.95	79.6	2.79	29.94	81.4	3.58	29.99	82.2	8.93
1897	29.96	78.1	1.33	30.01	78.8	1.49	29.96	79.0	2.64	29.96	81.4	2.21	29.94	79.8	8.50	29.99	82.2	3.79
1898	30.00	78.5	1.98	29.87	79.4	1.02	29.98	77.5	2.36	30.01	78.3	1.43	29.98	82.3	2.25	30.01	82.5	2.76
1899	30.02	75.2	3.86	30.09	75.5	1.21	30.04	75.2	1.00	30.01	77.5	2.34	30.03	79.5	0.53	30.03	80.2	3.57
Monthly means	29.99	78.1	3.66	30.00	78.3	1.89	29.99	78.9	2.07	29.98	80.2	3.32	29.97	81.5	4.18	30.01	82.6	4.00

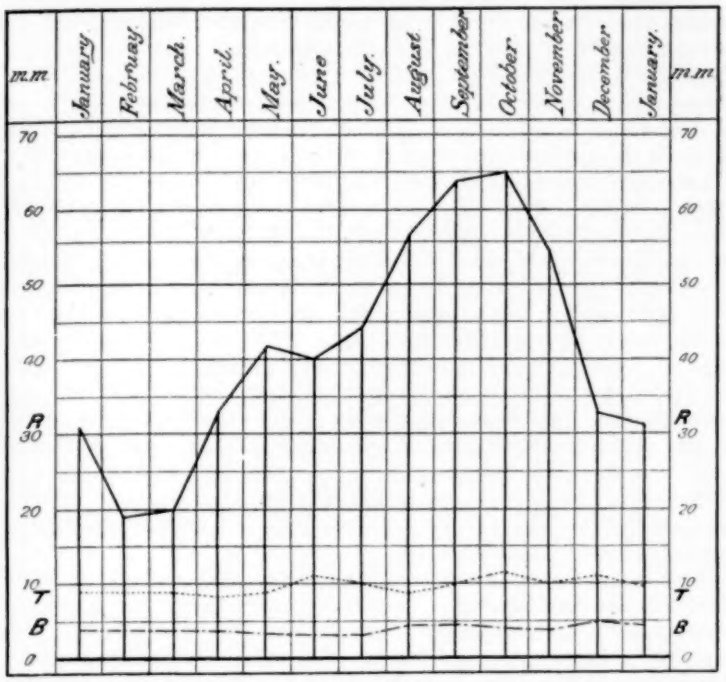

FIG. 1.—*R.* Graphic representation of the average monthly precipitation at Basseterre, St. Kitts, W. I., based upon forty-four years' record. *B.* Average range of barometric pressures for each month. *T.* Average range of temperature for each month. The ranges are based upon one year's record. Scale used in drawing these curves: 1 mm. equals 0.10 inch of rain, or a range of 1° in temperature, or a range of .02 inch in barometric pressure.

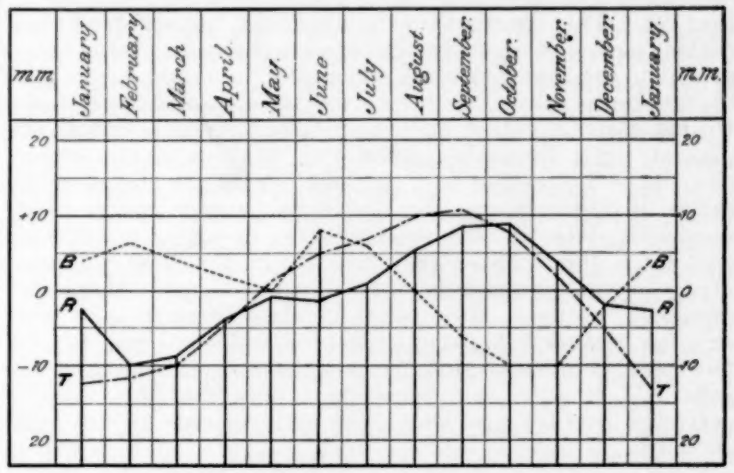

FIG. 2.—Graphic representation of the departures of the monthly means of barometric pressure, temperature, and rainfall. The zero line, or normal, corresponds to 29.97 inches of barometric pressure, *B;* and to 81.3° F. of temperature, *T;* and to 4.28 inches of rainfall, *R.* The mean barometric pressure and temperature are based on records extending over thirty-five years and the mean monthly rainfall on records extending over forty-four years.

Temperature (in Fahrenheit degrees).—Very much the same regularity noted in regard to barometric pressures characterize also the temperature changes, as will appear from a brief inspection of figs. 1, 2, and 3. The annual mean as obtained from the data contained in Table 1 is 81.3°, and that obtained from figures taken from the Richard barograph traces, covering one year, is 78.5°, a difference of a little less

TABLE 1.—*Showing the average monthly barometric pressure and temperature, etc.*—Continued.

Year.	July.			August.			September.			October.			November.			December.			For the year.		
	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Total rainfall.
	Ins.	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*
1856	30.03	83.9	5.05	30.02	84.6	2.60	29.99	85.2	1.75	29.95	84.2	9.30	29.93	81.4	6.40	29.99	79.3	2.85	30.00	82.5	48.30
1857	30.01	78.8	6.25	30.03	79.6	3.60	29.99	80.2	8.80	29.96	79.5	7.60	29.95	82.0	6.80	30.00	80.0	5.80	29.99	79.3	62.15
1858	30.04	82.0	1.40	30.00	82.9	7.10	29.98	83.6	6.10	29.92	82.3	12.20	29.95	80.4	11.00	30.00	78.1	5.10	30.00	80.8	62.30
1859	30.03	81.2	5.10	30.00	81.9	7.70	29.96	82.9	10.60	29.94	81.9	8.00	29.98	80.1	3.16	29.97	78.1	3.10	30.00	79.8	56.50
1860	30.00	84.5	4.20	29.89	84.4	11.80	29.94	84.6	7.90	29.91	83.9	8.10	29.90	83.3	3.70	29.98	82.2	2.00	29.99	82.4	52.20
1861	30.01	81.8	4.95	29.98	83.4	5.25	29.95	83.7	4.90	29.88	82.6	23.40	29.91	80.5	7.10	29.94	79.1	4.35	29.96	80.4	83.10
1862	30.00	82.1	3.25	29.97	82.0	5.90	29.91	83.7	11.80	29.92	80.8	14.25	29.91	79.7	5.40	29.95	77.7	9.35	29.97	80.0	66.85
1863	30.04	81.1	2.00	30.04	82.1	1.90	29.98	82.5	4.05	29.94	82.2	10.00	29.94	80.0	5.05	29.97	77.5	2.55	29.99	79.7	37.15
1864	30.01	82.1	2.00	29.97	82.4	9.90	29.96	82.7	9.05	29.94	82.3	8.00	29.92	81.0	5.05	29.97	79.3	3.55	29.98	80.3	48.15
1865	30.04	84.4	8.55	29.96	84.7	3.15	29.95	84.4	5.85	29.94	83.4	1.35	29.94	82.1	7.50	29.98	79.1	4.05	29.99	81.8	51.00
1866	30.01	82.5	3.20	29.97	83.5	2.85	29.95	83.4	4.95	29.91	82.8	8.40	29.90	81.4	2.10	29.97	78.7	2.65	29.98	80.4	48.75
1867	29.99	82.9	3.65	29.97	83.5	3.55	29.96	83.5	4.05	29.90	82.6	3.35	29.92	81.9	6.85	29.97	79.5	4.05	29.97	80.7	47.85
1868	29.97	83.8	2.95	29.97	84.6	2.45	29.91	83.9	10.05	29.89	84.3	5.85	29.91	83.1	4.90	30.01	81.9	3.05	29.96	82.0	40.00
1869	29.99	84.0	3.95	29.96	85.0	4.30	29.90	83.2	9.75	29.88	84.1	8.75	29.90	82.5	5.40	29.88	81.5	1.30	29.95	82.2	42.65
1870	29.98	82.2	6.65	29.89	83.6	8.45	29.89	84.6	4.35	29.87	83.1	7.10	29.88	82.0	5.60	29.92	79.9	9.60	29.93	81.3	61.00
1871	29.95	83.2	3.85	29.91	83.5	12.00	29.90	84.1	3.80	29.87	83.0	7.80	29.87	82.3	2.75	29.97	80.3	3.95	29.93	81.4	56.00
1872	29.97	83.0	4.05	29.93	84.5	4.35	29.88	83.6	15.15	29.89	84.6	4.95	29.89	81.5	6.20	29.94	80.8	2.55	29.93	82.1	45.85
1873	29.98	84.0	1.10	29.94	84.2	3.70	29.92	83.7	7.60	29.89	83.6	6.00	29.93	82.4	1.10	29.94	79.6	2.10	29.96	81.4	40.50
1874	29.98	84.3	2.30	29.97	84.8	2.35	29.90	84.3	9.60	29.88	83.4	4.30	29.91	81.8	3.85	29.94	79.8	3.55	29.94	81.7	39.60
1875	29.99	83.2	3.10	29.94	85.1	5.20	29.94	85.6	4.60	29.92	84.3	5.30	29.92	83.0	4.55	29.92	81.0	5.30	29.97	81.6	37.90
1876	29.96	84.3	5.30	29.95	85.2	1.95	29.92	85.3	5.50	29.90	85.2	4.45	29.88	84.5	2.95	29.95	82.7	4.35	29.94	82.2	54.75
1877	29.96	84.3	8.45	29.99	85.7	3.20	29.94	86.4	3.95	29.93	86.4	2.45	29.90	83.5	8.45	29.96	82.0	3.65	29.95	83.4	52.05
1878	29.97	84.5	9.10	29.99	84.2	6.60	29.92	86.3	4.80	29.90	85.1	4.10	29.91	84.6	5.15	29.97	82.0	2.40	29.96	83.3	66.55
1879	29.99	85.0	5.55	29.94	83.9	7.15	29.97	85.9	5.85	29.94	83.7	6.35	29.90	82.4	7.50	30.00	80.7	2.05	29.96	82.6	67.00
1880	30.02	84.4	6.15	29.95	85.4	2.10	29.97	85.9	2.10	29.94	85.9	1.45	29.97	83.4	5.05	29.98	82.1	1.65	29.99	82.4	68.00
1881	30.01	86.0	2.55	29.94	85.7	19.98	29.94	85.9	2.95	29.99	85.8	5.10	29.91	83.8	6.45	29.96	80.4	2.55	29.97	83.3	60.08
1882	30.03	85.4	3.70	30.00	86.5	5.85	29.98	85.2	5.60	29.92	85.0	6.80	29.89	83.0	4.45	29.97	81.9	3.15	29.99	83.0	35.25
1883	.....	.....	4.45	.....	.....	7.20	.....	.....	6.25	.....	.....	4.24	.....	.....	3.96	.....	.....	6.95	.....	.....	57.83
1884	.....	.....	1.50	.....	.....	4.12	.....	.....	4.25	.....	.....	5.15	.....	.....	3.60	.....	.....	5.80	.....	.....	41.79
1885	.....	.....	1.72	.....	.....	6.54	.....	.....	2.54	.....	.....	9.08	.....	.....	7.98	.....	.....	3.64	.....	.....	44.50
1886	.....	.....	7.50	.....	.....	5.50	.....	.....	15.06	.....	.....	5.71	.....	.....	5.63	.....	.....	3.51	.....	.....	59.70
1887	.....	.....	4.25	.....	.....	5.12	.....	.....	5.79	.....	.....	5.00	.....	.....	9.10	.....	.....	2.40	.....	.....	49.50
1888	.....	.....	6.98	.....	.....	8.03	.....	.....	3.64	.....	.....	5.64	.....	.....	1.86	.....	.....	1.65	.....	.....	46.67
1889	.....	.....	3.92	.....	.....	5.02	.....	.....	6.84	.....	.....	5.02	.....	.....	3.46	.....	.....	2.47	.....	.....	60.40
1890	.....	.....	5.60	.....	.....	3.60	.....	.....	5.52	.....	.....	4.76	.....	.....	1.81	.....	.....	4.02	.....	.....	40.44
1891	.....	.....	5.45	.....	.....	7.49	.....	.....	4.98	.....	.....	10.91	.....	.....	7.22	.....	.....	4.26	.....	.....	49.91
1892	30.06	86.0	2.74	29.98	86.8	9.98	29.98	85.9	5.90	29.93	85.8	3.61	29.90	82.2	8.57	29.96	80.9	2.39	30.00	82.6	47.65
1893	29.96	81.6	5.92	29.94	83.0	2.98	29.94	81.6	6.74	29.84	81.0	3.90	29.90	80.3	1.70	29.94	77.6	3.87	29.96	79.9	42.35
1894	30.03	82.0	2.16	29.98	82.8	3.81	29.94	82.4	4.39	29.92	79.8	7.28	29.94	80.0	6.53	29.96	77.7	6.28	29.98	79.6	43.22
1895	30.01	82.5	3.89	29.93	82.7	7.05	29.92	82.0	9.32	29.90	81.6	5.22	29.90	80.5	3.00	29.88	78.3	5.69	29.96	80.4	54.24
1896	30.00	82.3	6.30	29.96	83.4	3.80	29.90	83.4	7.46	29.90	82.6	4.15	29.89	79.4	14.37	29.95	79.4	2.54	29.95	80.6	61.84
1897	29.98	81.7	5.64	30.00	83.6	3.11	30.00	84.0	2.15	29.96	82.6	1.78	29.95	81.1	2.53	29.98	80.3	2.74	29.97	81.0	37.91
1898	29.98	84.3	7.57	29.97	82.8	7.78	29.94	79.6	12.37	29.96	79.4	4.47	29.94	76.8	4.42	30.03	75.8	3.69	29.97	81.2	52.10
1899	30.00	80.6	2.51	29.96	81.0	3.26	29.97	81.2	5.14	29.91	80.6	6.64	.....	.....	.....	.....	.....	.....	30.01	78.6	30.06
Monthly means	30.00	83.1	4.46	29.97	83.8	5.67	29.94	83.9	6.45	29.92	83.3	6.54	29.92	81.9	5.35	29.96	79.9	3.78	29.97	81.3	51.66

than 3°. This discrepancy is, no doubt, largely due to imperfect exposure of thermometer and the unfavorable hours at which the readings were made—9 a. m. and 4 p. m. The highest temperature recorded since the establishment of the United States Weather Bureau station in August, 1898, to the present time, November, 1899, was 89.4°, and the lowest, 65.1°, thus indicating very narrow limits for the absolute range of temperature, the limits of average range being necessarily less. It is also interesting to note in connection with fig. 3, the remarkable regularity in the hourly departures of the temperature for the three months there represented, February, May, and August. These months were selected because February is regarded as the coldest, May the most nearly normal, and August the hottest month of the year. It is quite safe, therefore, to say that the island is perfectly free from sudden and extreme changes of temperature.

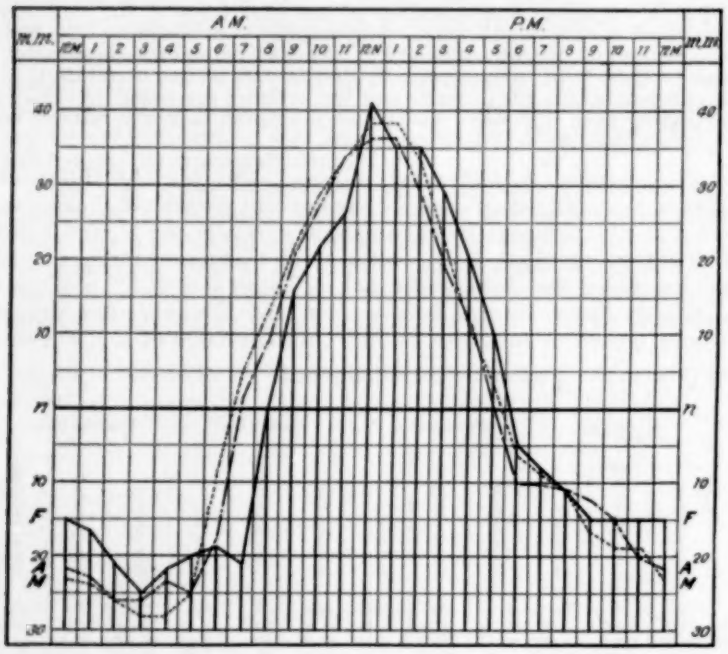

FIG. 3.—Graphic representation of the departures of the hourly from the monthly mean temperature for the months of February, May, and August, 1899. The means are taken from a Richard thermograph. The line *nn* represents the normal, or monthly mean, for February, 75.9°; for May, 79.4°; and for August, 81.0°.

Precipitation (*in inches*).—The rainfall in St. Kitts is more frequent than heavy, 0.27 inch being the average amount for each day of precipitation. Only eleven times in forty-four years, or once in every four years has the fall reached or exceeded 5.00 inches in twenty-four hours, and only forty-four times in forty-four years, or once a year, has the fall amounted to 2.50 but less than 5.00 inches in twenty-four hours, while the average number of days with 0.01 inch or more is more than 50 per cent of the total for the year. The average precipitation for the month is 4.28 inches and for the year is 51.66 inches. In as much as the records from which these averages were obtained are the records of the rainfall at Basseterre alone, it is probable that they would be altered slightly if the fall at various parts of the island were taken into the count. It is hoped that this point may be treated more fully at some future time. The departures of the monthly means from the normal are clearly shown in fig. 2, while fig. 4 enables one to ascertain the departures of the total annual fall from the normal for the past forty-four years. The precipitation is decidedly least during February and March, while the greatest amount falls in September and October, or, to state it in another way, 37 per cent of the annual fall occurs during the first half of the year and 63 per cent during the last half.

The intimate relation between the rainfall and agriculture justifies the introduction in this connection as a hint along this line, to be followed, perhaps, by a more elaborate discussion. Fig. 4 is an effort to present this relation graphically, but as the curves are based upon data for the calendar year, in order to avoid fallacious deductions this figure must be studied with great care, remembering that the crop for any particular year is afforded only by the rainfall of the preceding year, as for instance, the crop of 1898 is the result of the rainfall of 1897, and so on. It requires at least twelve months to grow and harvest a crop of cane, but as the "crop year" properly begins about the middle of March it does not correspond to the calendar year.

Bearing in mind that the critical period in the history of a cane crop, that is the time at which it is most important to have plenty of rain, is from August to December, more especially October and November, and that very little rain is needed during the harvest months, January, February, and March, it may be readily seen, by glancing at fig. 1, how perfectly the rainfall of the island fulfills these conditions.

The average yield per acre, as given in fig. 4 (1,615 pounds), does not represent the *actual* yield per acre for the reason that it is based upon the number of acres in cane and not not upon the number of acres harvested. Take, for instance, an estate of 500 acres; 200 acres, say, will be in "plant canes" and will form a part of the crop of the following year, while the remaining 300 acres will be harvested this year. Now, the average above mentioned is based upon the entire acreage. The actual average would probably lie between 2,500 and 3,000 pounds per acre.

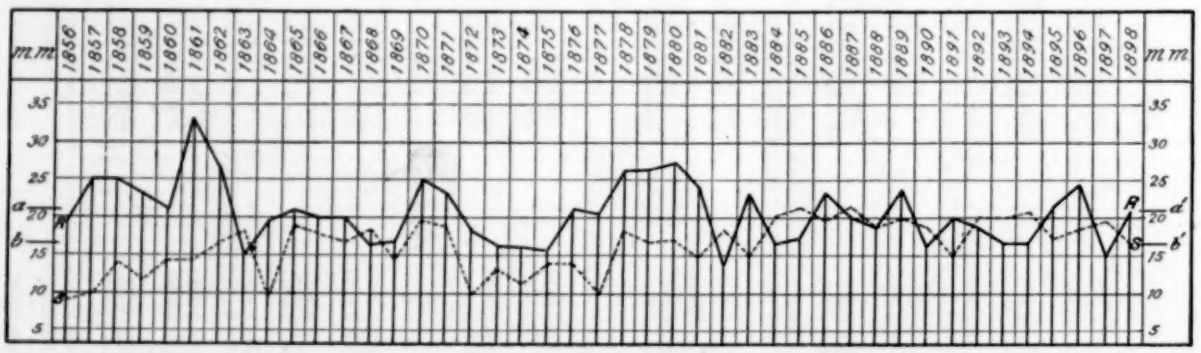

FIG. 4.—*R*. Graphic representation of the total annual rainfall at Basseterre, St. Kitts, W. I., for a period of forty-three years. *S*. The average yield per acre of sugar for the same period. A line drawn from *a* to *a'* would represent the average annual rainfall, 51.66 inches, for the forty-three years, and one drawn from *b* to *b'* the average yield per acre, 1,615 pounds of sugar.

TABLE 2.—*Showing the monthly averages of barometric pressures, temperature, and rainfall at Basseterre, St. Kitts, together with the average number of days on which .01 inch, or more, of rain fell; an average rain (average amount divided by average number of days), and total number of days with 2.50 inches or over. The averages are based on periods of years as indicated at top of each column.*

Months.	Average monthly— Barometric pressure (35 years).	Temperature (35 years).	Rainfall (44 years).	Average No. days with .01 inch or more of rainfall (8 years).	An average rain.	Total No. of days with— 2.50, but less than 5.00 inches of rain (44 years).	5.00 inches or more of rain (44 years).
January	29.99	78.1	3.66	16	.23	1	1
February	30.00	78.3	1.89	14	.14	1	0
March	29.99	78.9	2.07	11	.19	0	0
April	29.98	80.2	3.32	11	.30	3	0
May	29.97	81.5	4.18	15	.28	7	1
June	30.01	82.6	4.00	17	.23	1	0
July	30.00	83.1	4.46	19	.23	2	1
August	29.97	81.8	5.67	18	.32	7	2
September	29.94	83.9	6.45	18	.36	7	2
October	29.92	83.3	6.54	16	.41	7	2
November	29.92	81.9	5.35	16	.33	4	1
December	29.96	79.9	3.78	15	.25	2	1

RAINFALL IN CENTRAL AND WESTERN NICARAGUA.

By EARL FLINT, dated December 13, 1899.

In selecting records of rainfalls I find only three reliable ones, taken at the cities of Masaya, Granada, and Rivas during a period of eleven years, from 1886 to 1896, and giving a mean rainfall of 61 inches and a fraction, including three maximum records at Rivas. The mean fall at the latter city for a period of nineteen years is 68.09 inches, including the abnormal rains in the years 1897 and 1898. I hold the belief that henceforth if records be taken throughout the state the mean fall will be found to be less than 61 inches.

I noted a decrease of the rainfall in 1863, and many old residents had noted the same, which fact was confirmed by the drying of the marshes north of Granada and of the Tipitapa Falls, occurrences not previously remembered. In that year in going around the lake to Talolinga I passed above the outlet of Tipitapa on my way across to Managua. I noticed neither a change in temperature nor a sign of subterranean outflow. What, then, but a slight rainfall would account for the above said decrease? There were no records kept, only the observations made by intelligent citizens. At that time Mr. Espinola brought a rain gage and kept records until 1877. I did not send any complete record until charts and forms were sent for the simultaneous international observations of the Signal Service, now succeeded by those of the Washington Weather Bureau. These I have forwarded complete.

In 1875, during my correspondence with Professor Baird, I again called his attention to the continued closure of the outflow at Tipitapa, which he attributed to a subterranean outlet, while I thought it was due to light rains. Without any records for reference I could only rely on observations of others, aided by personal ones, made on the north and northeast watersheds of Lake Nicaragua. When I went to La Libertad I saw verified the decreased supply that I had foretold, due to deforesting the source of the streams supplying the native arrastras. This water power was soon abandoned for steam power. On the Rivas plateau several small streams which used to run throughout the year are now dry, save in years of maximum rainfall.

In this way I accounted for the great accumulation of detritus at San Carlos, at that time impeding navigation at the entrance of the river. I then asserted to Professor Baird that its continued deposit would within a quarter of a century block the outlet in the dry season, of course counting out the supply of water from Lake Managua, and a diminishing rainfall. The deposit kept on increasing until the outflow at Tipitapa was renewed in 1878. It yet closed again two years between 1881 and 1890. The exact date Mr. J. Vasconcelos, an old resident, could not remember, yet he asserts its closure in 1891 and in 1892, Mr. J. L. Talavera and Mr. William Climie, C. E., confirming the same in 1896.

Should the outlet again close for a series of years, an event more than probable in view of the increasing cultivation along the streams and the sources which now feed the lakes, this would diminish the supply necessary for the proposed canal to connect the lakes and render the canal useless in the dry season, excepting during maximum rainfalls on the watershed. At an early date I suggested the union of the Sebaco rivers so as to increase the supply necessary for the main canal, which supply must, in my opinion, be attended to early, before the augmenting commerce will require more than double the quantity of water necessary when the canal is first finished. This union, according to Mr. Masey, could be done at a small cost.

By replanting the arid plateaus north and east of the lake, selecting trees of the most useful kind, the evaporation already noted would be diminished to at least 50 per cent, it would tend to keep the rivers from drying up to a great extent in the dry season. By this method the object aimed at will be obtained over the country drained by both lakes, that is to say over an area of about 15,000 square miles, much of it mountainous.

If these conservative measures are not adopted we may in a few years see Lake Managua standing below its present outlet as an isolated inland lake.

Judging from past observations we may expect soon to see a repetition of the closure of 1863, since there are this year many corresponding meteorological phenomena: First, the prolonged northeast winds that always check abundant rainfalls, so that now, as then, the crops have suffered in the eastern section of the state; second, in 1861 fell the heaviest rainfall since 1825, thus allowing a large lake steamer to come up from Greytown in two and a half days, passing all the rapids with ease. The year 1899 has been preceded by the maximum of 1897 and 1898, the two greatest in twenty years, the latter nearly double that at Tipitapa, whose light outflow this year is due to *excessive* rainfalls about the head of the lake, yet we fear its closure in 1900 for a series of years as in 1863.

TABLES OF DEW-POINT OBSERVED AT HONOLULU.

By CURTIS J. LYONS, dated August 19, 1899.

In communicating the following tables of dew-point, Mr. Lyons says:

I would venture to suggest that one enter the humidity tables with the average temperature of the month and the average dew-point and take out the required average humidity. For instance, San Francisco, with a mean temperature of 55.1° and a mean dew-point of 47.5° for 1897 (see Annual Report of the Weather Bureau), would have a mean relative humidity of 74.5°, whereas the published mean is 79.5° from the mean of the 8 a. m. and 8 p. m. observations. The humidity at Honolulu derived from 9 a. m. and 9 p. m. local observations and verified by the method above mentioned is 72 per cent. I have found the above method to generally give about the same result for the same hours, and for this reason I have used the above hours (9 a. m. and 9 p. m., local time) for the past eight years.

The dew-point here is an important item in endeavors to predict weather changes. A fall of the dew-point during trade-wind weather is almost always followed within from twenty-four to thirty-six hours by showers, not cyclonic rains, but the common trade-wind shower, is probably caused by the interpenetration of northerly upper currents. Probably the northern currents are caused by distant lows passing north of this place.

[The annual mean temperature of 55.1° used by Mr. Lyons in the example above cited was derived from the daily extremes and differs by 1.3° from the annual mean derived from observations at 8 a. m. and 8 p. m. Entering the humidity

tables with the proper mean temperature, viz, 53.8°, and mean dew-point, 47.5°, one gets for the humidity 79.8 per cent, which agrees with the published mean within less than one-half of one per cent.

The monthly means of the dew-point, relative humidity, and vapor pressure are given in the annual volumes as computed directly from the daily observations.—A. J. H.]

Annual record of observations for dew-point only during 1898, *by Curtis J. Lyons, at Honolulu,*

Lat. 21° 18′, long. 157° 50′; ground above sea, 43 ft; thermometer above ground, 9 ft.

Day of month.	January.				February.				March.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	60	62	67	64	62	66	66	66	58	54	56	57
2	66	66	61	63	66	70	67	70	55	59	*40	50
3	57	61	64	63	68	69	67	61	52	52	52	54
4	62	65	63	62	57	61	64	61	57	60	58	57
5	61	61	61	61	55	61	62	66	57	56	56	57
6	62	63	66	64	58	65	68	63	61	59	59	58
7	63	64	64	65	59	64	68	64	59	58	58	59
8	61	65	64	59	59	66	63	59	58	61	61	61
9	58	63	63	60	62	68	68	64	59	61	62	59
10	59	62	64	63	60	66	66	62	62	62	62	61
11	61	63	65	64	66	68	69	67	61	62	62	60
12	60	68	65	63	61	61	64	62	63	65	62	63
13	56	65	65	67	61	62	64	59	68	68	66	67
14	62	64	67	64	55	55	59	57	67	70	68	68
15	61	63	61	59	[57]	58	62	57	68	69	69	68
16	61	61	66	64	58	62	65	62	68	69	70	71
17	59	65	66	63	63	67	66	66	68	69	71	69
18	59	63	67	61	64	70	68	64	68	69	68	66
19	66	67	68	64	65	66	67	62	68	69	68	68
20	61	67	69	67	[64]	65	66	67	67	69	66	66
21	59	67	67	69	[67]	69	64	65	66	66	62	64
22	64	67	67	64	62	62	63	61	66	64	65	63
23	64	62	64	61	63	68	68	66	66	64	64	64
24	61	64	66	63	67	66	61	63	63	63	62	62
25	59	62	62	62	64	67	66	61	63	62	64	62
26	64	67	67	67	58	59	58	53	64	64	65	65
27	61	63	63	62	55	58	62	55	67	65	66	66
28	59	58	59	59	54	50	55	53	67	63	63	62
29	60	61	63	60	.....	.....	.....	.....	61	59	61	60
30	56	59	62	60	.....	.....	.....	.....	60	59	61	60
31	61	63	63	66	.....	.....	.....	.....	57	59	59	57
Means	60.7	63.6	64.5	63.0	61.0	63.9	64.1	62.0	62.7	62.9	62.1	61.7
Monthly m's	62.9				62.5				62.3			

Day of month.	April.				May.				June.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	58	57	57	59	66	66	64	62	63	63	62	65
2	59	56	59	59	63	63	64	65	65	65	64	64
3	58	59	59	60	66	66	65	64	66	63	63	66
4	59	56	58	60	63	62	64	64	63	63	63	63
5	59	59	58	60	64	63	62	65	62	63	61	63
6	57	57	58	59	66	67	62	62	64	64	66	64
7	58	58	62	62	64	62	65	63	65	64	68	68
8	59	59	60	61	61	60	59	61	69	69	69	66
9	62	62	61	62	65	63	64	62	66	67	66	65
10	62	61	62	61	61	62	60	63	66	68	65	65
11	62	62	63	62	63	63	61	62	63	62	62	64
12	65	63	63	64	65	63	62	61	64	63	64	63
13	63	62	62	62	61	61	60	60	64	66	65	66
14	65	63	63	61	61	61	60	60	65	65	62	63
15	63	63	64	62	65	67	61	63	67	68	65	67
16	62	60	61	63	63	62	64	64	64	64	65	64
17	63	64	62	63	63	65	65	65	64	66	67	68
18	60	62	61	62	63	62	64	66	66	66	64	64
19	62	61	61	60	62	63	64	64	67	68	66	66
20	61	63	59	62	62	63	64	64	64	62	64	66
21	65	63	62	61	62	62	63	62	65	66	64	67
22	64	64	64	65	62	62	62	62	67	70	72	71
23	65	64	65	65	61	61	61	64	69	70	68	66
24	66	66	65	64	65	64	63	64	66	68	64	68
25	65	65	61	64	68	66	63	68	66	67	67	66
26	64	63	62	64	66	65	66	66	70	68	68	66
27	66	64	63	64	64	65	64	65	65	65	65	63
28	63	67	64	66	66	64	64	63	63	61	64	63
29	66	65	67	66	67	66	64	65	66	62	62	65
30	66	66	65	64	66	66	66	65	64	66	65	67
31	.....	.....	.....	.....	64	65	65	65	.....	.....	.....	.....
Means	62.2	60.8	61.4	61.9	63.8	63.5	63.4	63.5	65.4	65.4	65.0	65.2
Monthly m'n	61.6				63.5				65.2			

*This extreme is correct. Bracketed figures are interpolated.

Annual record of observations for dew-point at Honolulu—Continued.

Day of month.	July.				August.				September.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	66	65	68	67	64	63	66	65	64	66	64	65
2	65	69	70	69	64	64	65	66	63	65	64	65
3	65	66	66	68	65	66	69	69	65	65	64	66
4	67	67	69	67	68	69	67	67	67	65	65	66
5	67	66	65	68	66	66	68	68	65	65	64	65
6	66	65	63	66	69	69	68	68	07	67	67	65
7	66	65	66	66	68	68	69	68	65	64	63	65
8	66	68	66	67	64	65	67	66	67	66	65	65
9	66	64	68	66	65	67	64	66	67	63	64	64
10	68	69	66	65	64	65	66	64	66	67	67	66
11	65	65	67	65	65	55	65	65	66	68	67	65
12	67	67	66	65	69	68	65	65	62	64	64	65
13	65	66	67	66	64	64	63	68	67	70	69	68
14	67	67	69	64	66	64	66	66	64	63	66	67
15	65	65	63	64	67	69	67	69	64	65	67	66
16	64	65	67	67	68	69	69	67	68	67	67	67
17	68	70	68	68	68	68	65	64	65	65	63	66
18	63	64	65	67	66	67	63	63	65	65	65	66
19	66	66	66	67	61	61	62	63	65	66	66	65
20	66	64	66	67	64	64	64	66	65	66	64	66
21	64	67	69	69	65	67	67	67	67	64	65	68
22	67	66	68	66	64	65	67	69	65	62	66	67
23	66	66	68	68	64	65	67	65	65	64	66	64
24	68	66	66	66	64	66	66	68	69	64	64	66
25	64	66	65	66	65	66	66	66	65	64	68	68
26	64	65	65	65	66	63	64	64	65	68	69	67
27	65	65	64	66	66	65	63	65	67	68	68	69
28	64	65	65	65	64	71	65	64	65	68	70	69
29	66	64	65	69	65	65	67	64	68	68	68	65
30	68	68	69	68	64	68	66	65	67	68	66	68
31	68	68	69	68	65	65	66	65	63	65	67	63
Means	65.9	66.1	66.6	66.5	65.4	66.1	65.9	66.0	65.5	65.5	65.6	65.9
Monthly m'n	66.3				65.8				65.6			

Day of month.	October.				November.				December.			
	A. M.		P. M.		A. M.		P. M.		A. M.		P. M.	
	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00	6:00	9:00	2:00	9:00
1	66	68	69	67	63	62	64	65	61	64	66	65
2	66	69	67	66	63	63	66	60	62	63	64	66
3	67	66	66	67	63	65	65	65	64	65	63	65
4	67	69	68	67	65	64	64	63	65	65	62	63
5	68	66	67	66	63	61	63	62	62	65	64	66
6	68	66	68	67	65	63	66	64	69	71	70	70
7	69	67	67	68	64	64	64	66	68	69	68	65
8	67	68	66	66	64	65	65	62	62	65	67	56
9	67	67	66	66	66	64	65	63	56	56	55	54
10	66	68	67	66	65	63	63	65	53	55	56	61
11	65	66	67	66	66	65	61	67	60	68	65	64
12	66	66	67	64	64	65	64	63	62	64	66	64
13	63	67	68	68	67	69	67	68	61	64	65	70
14	66	67	66	68	66	67	67	66	67	68	69	66
15	65	65	68	68	61	70	69	66	60	61	61	59
16	68	65	67	65	67	68	66	64	55	56	58	59
17	65	65	65	65	65	66	64	64	59	60	57	62
18	64	64	66	66	65	65	64	64	61	61	64	62
19	64	65	63	65	64	64	65	65	65	66	66	66
20	66	66	65	66	66	68	66	67	62	65	67	64
21	68	68	70	69	65	66	68	67	62	64	65	62
22	70	72	72	73	66	65	64	66	61	62	52	52
23	70	73	74	70	64	67	67	66	55	55	54	57
24	67	70	67	66	63	63	65	66	57	57	57	57
25	71	68	62	65	64	66	63	64	63	63	63	64
26	67	69	67	64	64	63	63	63	62	64	62	63
27	65	65	64	65	62	65	62	63	61	66	65	65
28	67	70	66	65	65	64	63	63	62	67	66	64
29	68	66	62	65	63	62	64	62	58	62	64	62
30	65	61	64	62	62	62	62	62	63	65	63	66
31	.....	.....	.....	.....	.....	.....	.....	.....	64	65	66	65
Means	66.5	67.0	66.7	66.3	64.6	65.0	64.6	64.4	61.3	63.3	62.9	62.6
Monthly m'n	66.7				64.7				62.5			

Mean dew-point for the year, 64.13° F.

THE WEATHER AND THE LIVE STOCK INDUSTRY.[1]

By F. H. BRANDENBURG, Local Forecast Official and Section Director.

Last year I had the pleasure of appearing before you and outlining a plan for promoting a closer relationship between the Weather Bureau of the Department of Agriculture and

[1] The above address was delivered January 18, 1900, at Fort Worth, Tex., at the annual convention of the National Live Stock Association.

the stockmen of the West. Acting on the suggestion offered, your secretary, Mr. Martin, obtained through the different local associations definite information as to the character of warnings desired in different parts of the vast region devoted to the live stock industry. The necessity for this action becomes apparent when we consider that weather conditions recognized as severe and destructive in southern latitudes would probably pass unnoticed a thousand miles farther north.

As promised a year ago, the Weather Bureau has been strengthened in the West, where the majority of our storms originate and gather energy while being held practically stationary by the mountains. When they finally reach the plains it is comparatively easy to foretell their course, since they commonly move rapidly eastward with the general circulation. The Weather Bureau officials stationed throughout the country are constantly upon the alert to detect the first signs of these disturbances, and, notwithstanding the difficulties which beset the forecasting of storms for points on the great plains, while the storm center is still under the influence exerted by the mountains, a high percentage of the forecasts of blizzards and kindred phenomena is verified, thus saving thousands upon thousands of dollars.

It is recognized that the ordinary cold wave, unaccompanied by high winds and snow, and lasting only a day or two, is of little concern to the stockman, even though a temperature 20° or 25° below the average be reached. This class of information is, however, of great importance to commercial interests. To give stockmen the fullest benefit of the information in possession of the Bureau, Professor Moore recently directed that when a prolonged spell of abnormally cold weather, high northerly winds with snow, heavy falls of snow, unseasonable or abnormally heavy rain is indicated for any section, notice thereof be given wide distribution. Messages of this character are known as emergency warnings, and are issued from the Central Office in Washington, D. C., and the station at Chicago, Ill.

During the spring of 1899 circular letters were sent to all postmasters in the West inquiring as to the interests in their respective localities, and asking their assistance in the dissemination of information. These letters naturally brought many offers of cooperation, and large additions have been made to the telegraph lists for the Western States. To give you an idea of how thoroughly such information is distributed, I would say that, exclusive of the hundreds of post offices receiving the daily forecasts by mail and cold-wave warnings by telegraph, messages relative to the approach of severe weather conditions are telegraphed to 30 points in Montana; 130 in North Dakota; 243 in Minnesota; 206 in Iowa; 133 in South Dakota; 8 in Wyoming; 80 in Colorado; 265 in Nebraska; 99 in Missouri; 238 in Kansas; 38 in Oklahoma; 5 in the Indian Territory; and 219 in Texas. These figures represent an increase of more than 30 per cent during the past year, and though the lists are large, it is doubtful whether all interested localities having telegraph facilities are included. In order that you may consult the lists, *copies have been posted convenient for your inspection*, and should you find that places important as regards live stock interests are not included, application should be made to the section director of your State, stating such facts as are pertinent thereto. I feel safe in saying that your request will receive prompt attention. For points in Montana, application should be made to the Weather Bureau official at Helena, and the other section centers are as follows: North Dakota, Bismarck; Minnesota, St. Paul; Iowa, Des Moines; South Dakota, Huron; Wyoming, Cheyenne; Colorado, Denver; Nebraska, Lincoln; Missouri, Columbia; Kansas, Topeka; Oklahoma and Indian Territory, Oklahoma; Texas, Galveston. West of the mountains the section centers are located at Boise, Idaho; Salt Lake City, Utah; Carson City, Nev.; Santa Fe, New Mex.; and Phenix, Ariz.

There is no industry, except agriculture, so materially affected by the weather conditions as that of live stock. It therefore appears to me that, in so far as it lies in his power, the stockman should avail himself of, and profit by the forecasts. Even though one may be provided with plenty of hay and shelter, notices of sharp changes are valuable to all branches of the industry, whether that of breeder or feeder. I realize that the success of your business depends upon grass, and plenty of it, as well as water, shelter, etc.—essentials that are often many miles from a town. This, however, is the age of the telegraph and telephone, facilities for the dissemination of information which twenty or thirty years ago were scarcely thought of in connection with your business. It rests with you gentlemen, to avail yourselves of the benefits to be derived from this information.

Another matter; there is probably no daily newspaper of importance that does not publish the weather forecasts, and, since the first editions are quickly despatched on fast trains, hundreds of small post offices are promptly reached. The press has been, and is invaluable in this particular. Many of the newspapers issued in cities where there is a regular station of the Weather Bureau publish meteorological tables showing the barometric pressure, temperature, rainfall, and state of weather at a great many points in the States lying between the British Possessions and the Gulf, or the Lakes in the East and the Pacific in the West. These reports can be utilized to advantage by the stockman, especially during the winter, if he will take the trouble to inform himself in regard thereto. This is easily done, since there is nothing mysterious about them any more than there is in connection with a list of sales reported from the stockyards at Kansas City, Mo., or Chicago, Ill.

The daily weather map is the means employed to show in full the conditions that prevail throughout the country at the time of the regular morning observation. With this publication one can keep himself informed as to the weather that is being experienced elsewhere. In brief, the map shows where the preceding twenty-four hours have been wet or dry, as well as the degree of heat or cold and all the other features of the weather about which an owner of live stock is sure to be concerned. It is our aim to furnish the map for display at all post offices that can be reached within a reasonable time after its issue.

It is fair to suppose that persons interested in live stock are more concerned about the character of the winters than they are about the character of any other season. All remember last winter only too well, and doubtless few care to see a repetition. A careful study of long records shows that a deficiency or excess of heat or moisture during a certain season or other period is eventually made good, but such compensating conditions generally take place so gradually as to be scarcely noticed. The character of the weather for a day, or month, or season, is controlled by the distribution of atmospheric pressure, or in other words, by the paths followed by the highs and lows shown on the weather map; since general and not local conditions exert the controlling influence, large areas are similarly affected. You have all at times noticed the persistency of stormy conditions, lasting perhaps for weeks; or a persistency of droughty conditions, which may continue for a month or two. When such conditions exist, it is found that there must be a marked and general change in the barometric pressure to effect a change of weather.

About fifteen years ago persons engaged in raising live stock on the public lands were exercised over the influx of settlers drawn westward by extensively circulated statements to the effect that the rainfall was increasing in the arid region, and that profitable agriculture was now possible without the aid

of irrigation. The records confirm the view held by live stock men at the time, which was that a successful prosecution of agriculture on the uplands would not be attained, except perhaps in a few localities where, by reason of the topography, the rainfall is ordinarily greater than on the plains. There is no reason to believe that the rainfall in recent years is any more or any less than it was before the disappearance of the buffalo from his great feeding ground. The stand of grass on the plains, however, might be taken by some persons as an indication of a diminishing instead of an increasing rainfall. We all know that during the past twenty years the ranges have been taxed to furnish sufficient pasturage, and, as a consequence of overstocking, the grass has been cropped too close. At present the arroyos carry off the bulk of the rainfall, but such would not be the case were the run-off checked by grass left from the preceding year. At the same time the old grass would reduce the rate of evaporation of such moisture as soaks into the ground. These facts, rather than any difference in the rainfall, are responsible for a poor stand of grass on so many of the ranges.

During recent years the stockmen of the far West have become more and more interested in farming operations, and such as do not themselves engage in the industry are only too glad to buy hay if it is to be had. The rainfall is very uncertain in the arid region, and the volume of water available for irrigation precludes any material extension of the agricultural districts. It is true storage reservoirs would improve the situation, but the expense of such undertakings would be too great for private enterprise. There is no doubt that the flow of our streams during summer and fall could be materially improved at a comparatively small cost. In the mountain districts there is a constant and generous flow under the ice in all the small streams during winter, no matter how cold the weather. To store this water for use during the following summer it is suggested that after suitable sheltered places have been selected the water be brought to the surface and allowed to spread over the ice. Even though only a small proportion of the flow be utilized, immense fields of ice could thus be formed, and if the site be protected from the west winds, the gradual melting would maintain a good flow throughout the season when water is generally scarce east of the mountains. It is believed that a concerted movement in this direction would prove profitable.

THE BAROGRAPH ON SHIPBOARD.

By JAMES PAGE.

On the pilot charts of the North Pacific and Atlantic oceans, respectively, for 1900, there is an excellent article by Mr. James Page, of the United States Hydrographic Office, explaining the use of the barograph at sea. The Richard self-registering aneroid barometer is now sold at a price equal to or less than the former prices for a thoroughly reliable simple aneroid itself; its mechanism is simple, it is handled more easily than the ordinary ship's barometer, and gives far less trouble in the matter of making and keeping records. We think it important to reproduce the diagram and the article by Mr. Page as an excellent illustration of the value of the instrument. Having used one ourselves for a long time on shipboard and having seen conservative old captains convinced of its value in the navigation of a vessel, we need only say that the experience of all justifies the statement that every sailing vessel and every steamer should have one of these self-registers in addition to its standard mercurial.

The accompanying diagram is a facsimile of a portion of the pressure curve drawn by the self-recording aneroid barometer on board the Alaska Commercial Company's S. S. *Portland*, Capt. C. E. Lindquist, during a voyage from San Francisco to St. Michael, Alaska, September 3–21, 1899. Owing to lack of space the diagram is limited to portions of the curve included between Monday, September 11, and Wednesday, September 13, the position of the vessel at each successive noon being given under the date at the top of the diagram. In the lower portion are entered for the indicated hours the direction and force of the wind and the character of the weather, the Beaufort system of notation being employed throughout. These entries are copied from the log of the vessel and are made after the sheet has been removed from the cylinder of the instrument.

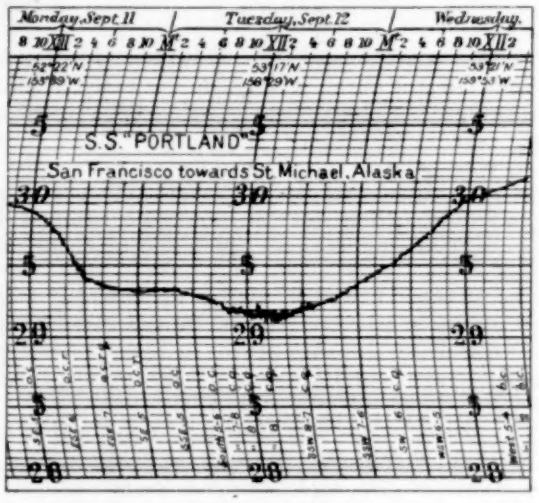

FIG. 1.

One of the most valuable results to be derived from the consideration of these barograms, as curves such as the present are called, is the evidence which they afford of the intimate relation existing between the state of the barometer and the direction and force of the wind. In the middle and higher latitudes of the North Pacific the direction of motion of the areas of low barometric pressure, which invariably accompany periods of stormy winds and foul weather, is in general eastward, the average path followed by the center of these areas being shown upon the Pilot Chart for the current month. Around the center of such an area, in accordance with the well-known principles of the law of storms, the winds circulate in a negative or anticlockwise direction. In advance of the center southerly and southeasterly winds will thus prevail, which will gradually shift to northwest as the center approaches and passes the observer's vessel, the shift taking place by way of north if the observer's position be to the north or left of the track, but through the south if it be to the south or right of the track. The barogram of the *Portland* and the accompanying wind and weather entries furnish an excellent example of the manner in which these shifts take place. At noon of Monday, September 11, in latitude 52° 22′ N., longitude 153° 39′ W., the *Portland* experienced a falling barometer and southeast winds of force 5, with overcast sky, all tending to show the existence of a center of low pressure to the westward. As the day advanced the barogram shows that the pressure diminished rapidly; that the weather became rainy and squally, and that the winds, while increasing in force, remained fairly constant in direction, conditions from which either one of two conclusions may be drawn, viz, either that the depression was for the time stationary but at the same time increasing rapidly in depth, or that the motion of the storm center was carrying it directly toward the position of the *Portland*. The reports of the storm received from other observers, however, confirm the second supposition. Thus the log of the U. S. revenue cutter *Thetis*, lying in Dutch Harbor, Unalaska Island (latitude 54° N., longitude 166° W.), shows that during the twenty-four hours intervening between 1 a. m. of September 11 and 1 a. m. of September 12 the barometer fell from 29.59 inches to 28.67 inches, the winds meanwhile backing from south-southeast, force 5, to east-northeast, force 10. At 6 a. m. of September 12, the barometer of the *Thetis* reached its lowest point, 28.55 inches, wind north, force 10, backing to northwest and west, showing that the center was steadily advancing, and also that the vessel lay to the north or on the left hand of the storm track.

At 8 p. m. the pressure, according to the *Portland's* self-registering aneroid, became almost stationary, and so continued, with winds of diminishing force, until 4 a. m. of the following day, at which time the decrease of pressure recommenced and continued until 3 p. m., when the minimum, 29.12 inches, was reached. From the hour at which this second fall set in the shifts of the increasing winds were steadily westward, passing through south about the time of lowest barometer, showing that the position of the *Portland* was to the southward or right of the line along which the center of the storm was traveling, just as the shifts observed by the *Thetis* showed that the latter vessel lay to the north or left of the track. Immediately after the minimum a

steady rise set in, the winds continuing to veer without interruption, but at the same time diminishing in force, while the weather continued to improve until normal conditions were reestablished. A practically similar sequence of wind and weather may be noted for each depression shown by the curve.

For strictly accurate observations aboard ship the aneroid barometer can never take the place of the mercurial. For ordinary daily use, however, the self-registering aneroid has much to recommend it in the fact that it furnishes automatically a complete record of the changes which take place between the hours of observation, and this in the shape of a continuous curve, as shown in the diagram—a shape which is much more intelligible to the ordinary observer than a series of figures. Especially is such a record of importance in the tropics, where the only variation to which the barometric pressure is subject under normal conditions is the daily double oscillation, which by the use of the self-registering aneroid is made apparent to the eye. In these waters one of the most unfailing indications of the approach of a hurricane is the interruption of this wave-like motion in the pressure, and in the curve drawn by the self-registering aneroid such an interruption can not escape notice, while its detection in the case of a mercurial barometer demands a series of (at least) hourly readings, each of which must be corrected for temperature before tabulation.

Turning now to the ordinary aneroid, it is hard to imagine a case in which the self-registering instrument can not be substituted for it with advantage. Both instruments are, of course, liable to be disturbed by an accidental jar or shock. In such an event the index hand of the aneroid furnishes no intimation of the occurrence, whereas the self-registering instrument will reveal at a glance both the time and the extent of the disturbance. The determination of the initial error by means of comparison with a standard mercurial is also much simplified in the case of the recording instrument. The cost of the latter is but slightly greater than that of the ordinary aneroid, and the only additional trouble entailed is the weekly task of placing the paper upon the cylinder and winding the clock.

The only point upon which confusion may arise in the use of these instruments is in respect to the time. If the clock is started in accordance with San Francisco time, for example, the entire sheet will, of course, represent the local time of that port, and the successive noons and midnights will denote, respectively, noon and midnight for San Francisco. To convert the hours shown upon the barogram into ship's (local) time, a correction must therefore be applied to the indicated times, the amount of which will depend upon the longitude east or west of San Francisco, or of whatever port or longitude is represented by the sheet. A note should always be made on the sheet, stating with what local time it corresponds. The initial error of the aneroid as determined by comparison with a standard mercurial should also be stated.

NOTE BY THE EDITOR.

THE METEOROLOGICAL CENTURY.

The question as to when the nineteenth century ends has been widely discussed. It is evident that we are using the word century in two slightly different significations, viz., either as a consecutive interval of time, or as a series of isolated numbers or things. From the latter point of view we speak of the numbers 1 to 100, or 0 to 99 as a century. On this basis we have a century of poems, or men, or other integral units, and a century of years may begin and end when we will. On the other hand we may use the word century as an interval of time; thus, from the beginning of any epoch to the end of the first year is an interval of one year. In mathematical language we indicate any portion of this year by a cipher followed by a decimal point and the proper numerals. When 99.99 years have elapsed we are near the close of the first century of elapsed time. As a series of numbers 1900 is the first year of the twentieth century. As a record of elapsed time January 1, 1901 is the beginning of the twentieth century.

The Meteorological Congresses and Committees meeting at Leipsic, 1872, Vienna, 1873, Utrecht, 1874, Rome, 1879, Paris, 1885, Zurich, 1888, Munich, 1891, Paris, 1896, adopted resolutions requiring that the following system be adopted in taking averages of meteorological data.

(*a*) This century is to be divided into decades. The first decade begins January 1, 1801, and ends with December 31, 1810, inclusive. This may be divided up into two lustrums, beginning, respectively, January 1, 1801, and January 1, 1806. In other words the meteorological century begins with January 1 of the year one, and ends with December 31 of the year 100, and so for each successive century.

(*b*) The year is to be divided into pentades of five days each, as first used by Dove. The first pentade includes the whole of January 1, 2, 3, 4, and 5. There are therefore 73 pentades in the year. When leap year occurs the pentade in which February 28 occurs is to include the 29th also, and, therefore, has six days in place of five.

(*c*) The day is divided into twenty-four hours, beginning and ending at midnight, mean local time. The first observation of the day is to be that taken at 12 o'clock, midnight, or 24 o'clock, midnight, if a 24-hour numeration be used. The numeration 24 m., 1 a. m., 2 a. m.———24 m. is to be preferred to the numeration 0 m., 1 a. m.———23 p. m., 0 m.; but the latter may be used in the publication of meteorological tables. The expression 12 p. m. is recommended for the midnight hour, and 12 a. m. for the midday hour in case the numeration 1^h———24^h is not used.

(*d*) In taking daily means of twenty-four hourly observations the formula indicated by the method of quadratures is to be followed, viz:

$$\text{Daily mean} = \frac{[\frac{1}{2}(24^h_1 + 24^h_2) + 1^h + 2^h \ldots\ldots + 23^h]}{24}$$

The first twelve hours, viz, 1 to 12 are to be considered as belonging to the morning; the following twelve, viz, 13 to 24 as belonging to the afternoon.

TABLE I.—*Annual climatological summary, Weather Bureau Stations*, 1899.

Districts and stations.	Elevation of barometer above sea-level.	Pressure in inches.†			Temperature of the air, in degrees Fahrenheit.							Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation.			Winds.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall, in inches.‡
		Mean actual, 8 a. m. + 8 p. m. ÷ 2.	Mean reduced.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Mean maximum.	Minimum.	Mean minimum.	Annual range.			Total, in inches.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Max. velocity. Miles, per hour.	Max. velocity. Direction.					
New England.					47.7	+0.4							76	36.29	— 7.32								5.5	
Eastport, Me	76	29.92	30.01	+.05	42.1	+0.6	80	49	−12	35	92	35	79	36.44	— 8.74	136	94,417	w.	72	ne.	93	123	149	6.2	95.3
Portland, Me	103	29.89	29.99	+.01	45.7	0.0	93	53	−10	38	103	36	71	34.07	— 8.19	120	64,444	nw.	48	n.	120	127	118	5.4	115.3
Northfield, Vt	876	29.08	30.04	+.03	41.4	+0.2	92	52	−25	31	117	34	76	36.36	— 9.38	144	77,370	s.	50	*	75	138	152	6.4	90.1
Boston, Mass	125	29.90	30.04	+.05	50.2	+1.6	94	58	— 4	42	98	39	69	34.69	−10.27	114	96,327	sw.	58	ne.	153	89	123	4.8	71.1
Nantucket, Mass	12	30.03	30.04	+.02	49.4	+0.6	82	55	— 2	44	80	43	82	38.93	−11.80	139	101,153	sw.	53	e.	99	115	151	6.1	44.7
Woods Hole, Mass	22	.....	.....	.....	49.5	+0.7	82	55	— 5	44	77	.....	.....	38.04	— 6.57	118	125,518	sw.	72	nw.	137	99	129	5.3	45.1
Vineyard Haven, Mass.	.....	.....	.....	.....	51.4	+0.1	86	59	2	44	84	.....	.....	44.67	+ 1.71	117	80,195	sw.	46	se.	103	139	123	5.8	44.2
Block Island, R. I	36	30.02	30.05	+.03	49.2	+0.1	83	55	0	44	83	42	77	41.31	— 2.88	123	131,498	sw.	71	n.	158	110	97	4.5	43.3
Narragansett, R. I	.....	.....	.....	.....	48.8	+0.2	92	57	— 8	41	100	.....	.....	43.09	— 4.41	104	.....	nw.	.....	.....	234	35	96	.....	49.5
New Haven, Conn	106	29.93	30.04	+.03	49.6	+0.2	95	58	— 9	41	104	41	75	35.28	−12.63	107	76,031	sw.	48	ne.	151	125	89	4.7	66.4
Middle Atlantic States.					53.3	+0.4							75	38.93	— 4.82								5.2	
Albany, N. Y	97	29.95	30.06	+.05	49.0	+0.8	94	58	−10	40	104	40	75	28.92	— 8.94	118	66,832	s.	46	e.	102	127	136	6.0	75.3
Binghamton, N. Y	875	.....	.....	.....	47.5	+1.1	94	57	−15	38	109	.....	.....	23.50	−13.78	127	55,715	nw.	39	w.	90	111	164	6.3	52.1
New York, N. Y	314	29.72	30.06	+.02	52.6	+0.9	97	60	— 6	46	103	43	74	42.06	— 2.74	117	120,350	nw.	80	n.	128	127	110	5.1	58.3
Harrisburg, Pa	374	.....	.....	.....	52.2	+0.7	95	60	−13	44	108	.....	.....	33.98	−10.08	122	58,496	w.	45	w.	113	123	129	5.6	45.6
Philadelphia, Pa	117	29.95	30.07	+.02	54.5	+1.1	97	62	— 6	46	103	43	71	39.96	+ 0.12	114	85,627	sw.	43	se.	129	97	139	5.4	55.4
Atlantic City, N. J	52	30.01	30.07	+.04	51.8	−0.1	93	58	— 7	45	102	46	82	37.84	— 4.87	101	95,561	sw.	50	*	116	172	77	4.9	51.2
Baltimore, Md	123	29.98	30.06	+.01	55.0	−0.2	98	63	— 7	47	105	44	70	40.59	— 3.36	118	45,355	se.	30	*	147	111	107	4.9	51.1
Washington, D. C	112	29.96	30.08	+.02	54.4	−0.3	97	64	−15	45	112	44	74	44.02	+ 0.56	125	56,836	s.	48	nw.	171	98	96	4.5	53.4
Cape Henry, Va	.....	.....	.....	.....	58.8	+0.1	98	66	— 5	52	93	.....	.....	45.99	— 6.35	126	115,223	sw.	72	ne.	142	114	109	5.2	23.9
Lynchburg, Va	672	29.33	30.05	−.01	56.5	−0.4	98	67	— 3	46	101	46	74	52.91	+10.06	114	32,202	ne.	41	sw.	160	115	90	4.7	23.5
Norfolk, Va	91	29.98	30.08	+.03	59.4	+0.4	99	68	— 3	51	96	51	80	38.41	−13.67	122	81,618	ne.	50	ne.	175	101	89	4.5	19.2
Richmond, Va	144	.....	.....	.....	58.1	.....	100	68	— 3	49	103	.....	.....	43.90	.....	117	55,021	n.	38	e.	127	113	125	5.3	34.0
South Atlantic States.					63.9	+0.3							77	47.10	— 5.95								4.8	
Charlotte, N. C	773	29.25	30.07	+.02	59.8	−0.1	100	70	— 5	50	105	47	70	45.44	— 6.48	119	59,803	ne.	55	s.	136	98	131	5.1	12.0
Hatteras, N. C	11	30.06	30.07	+.03	64.2	+0.8	89	67	12	57	77	56	83	61.88	— 4.53	133	118,609	n.	105	n.	169	119	77	4.5	4.5
Raleigh, N. C	376	29.68	30.08	+.01	59.5	+0.4	100	69	— 2	50	102	50	78	52.93	+ 6.84	140	53,350	sw.	41	n.	160	116	89	4.5	29.2
Wilmington, N. C	78	30.00	30.09	+.04	62.6	−0.4	98	71	5	54	93	54	80	40.07	−14.27	120	74,561	ne.	45	w.	138	132	95	4.9	5.2
Charleston, S. C	48	30.05	30.10	+.04	66.6	+0.8	100	73	7	60	93	56	75	44.33	−12.41	115	101,201	ne.	58	nw.	96	202	67	4.9	3.9
Columbia, S. C	.....	.....	.....	.....	63.6	0.0	105	75	— 2	52	107	.....	.....	49.74	+ 2.19	114	.....	ne.	...	...	127	119	119	5.3	16.7
Augusta, Ga	180	29.88	30.07	+.03	64.2	+0.3	100	74	3	54	97	52	72	48.74	+ 0.42	103	56,206	ne.	42	n.	162	107	96	4.6	6.7
Savannah, Ga	65	30.00	30.06	−.01	67.0	+0.6	100	76	8	58	92	56	78	42.17	— 9.74	104	75,313	sw.	44	ne.	140	153	72	4.6	2.0
Jacksonville, Fla	43	30.02	30.07	+.03	69.4	+0.4	98	78	10	61	88	61	82	38.57	−15.55	117	67,251	ne.	48	w.	117	169	79	5.1	1.9
Florida Peninsula.					74.3	+0.2							79	51.77	+ 1.99								4.9	
Jupiter, Fla	28	30.00	30.03	.00	74.4	+0.8	93	80	28	68	65	66	80	61.93	+ 3.95	145	91,438	se.	52	n.	166	145	54	4.4	0.0
Key West, Fla	22	30.01	30.03	+.03	76.9	−0.2	90	81	44	73	46	69	79	29.55	— 8.91	110	88,229	ne.	49	nw.	137	182	46	4.6	0.0
Tampa, Fla	34	30.00	30.04	.00	71.5	−0.1	94	80	22	63	72	64	79	63.82	+10.92	116	57,047	ne.	37	s.	89	188	88	5.6	0.1
East Gulf States.					65.0	0.0							75	45.23	−11.29								4.1	
Atlanta, Ga	1,174	28.84	30.07	−.01	61.6	+0.4	97	70	— 8	53	105	49	71	42.42	— 7.96	119	84,174	nw.	50	w.	137	129	99	4.9	9.8
Pensacola, Fla	56	.....	.....	.....	67.8	+0.2	98	74	7	61	91	.....	.....	52.86	— 4.23	116	82,979	ne.	44	e.	170	106	89	4.6	2.1
Mobile, Ala	57	30.00	30.06	+.02	66.5	−0.2	99	75	— 1	58	100	59	82	46.96	−15.65	116	65,064	n.	42	*	230	73	62	3.6	2.0
Montgomery, Ala	223	29.82	30.05	−.02	65.5	+0.3	101	75	— 5	56	106	54	72	51.63	— 1.09	100	56,625	e.	43	w.	156	102	107	4.7	6.5
Meridian, Miss	375	.....	.....	.....	64.5	−0.5	97	74	— 6	53	103	.....	.....	44.84	−12.15	112	49,844	sw.	36	w.	142	123	100	5.0	6.2
Vicksburg, Miss	247	29.76	30.02	−.04	65.3	0.0	96	74	— 1	56	97	55	71	47.18	— 8.48	106	60,855	se.	42	w.	159	126	80	4.4	8.2
New Orleans, La	51	29.99	30.05	+.03	68.8	0.0	96	76	7	61	89	59	77	31.07	−29.45	110	74,650	se.	42	nw.	150	130	85	4.5	3.0
West Gulf States.					65.9	+0.2							73	34.40	— 8.76								4.6	
Shreveport, La	249	29.76	30.02	−.02	65.8	+0.6	104	76	— 5	55	109	51	67	23.10	−25.50	85	61,936	se.	39	se.	155	67	143	5.1	9.8
Fort Smith, Ark	457	29.52	30.01	.00	61.2	+1.4	103	71	−15	51	118	48	69	40.27	— 4.47	95	61,672	e.	44	w.	137	108	120	5.2	5.7
Little Rock, Ark	357	29.67	30.06	+.02	61.0	−0.5	100	71	−12	52	112	50	72	41.35	−12.28	99	64,753	nw.	60	nw.	152	127	86	4.6	9.8
Corpus Christi, Tex	18	29.97	29.99	−.02	69.9	−0.2	93	75	11	64	82	63	83	20.96	— 3.24	71	111,651	se.	47	ne.	161	114	90	4.2	0.0
Fort Worth, Tex	670	.....	.....	.....	63.9	.....	104	75	— 8	53	112	.....	.....	18.11	.....	67	88,497	sw.	38	s.	177[4]	132[4]	52[4]	4.2	6.5
Galveston, Tex	54	29.95	30.00	−.01	69.2	−0.6	93	74	8	64	85	61	80	41.76	— 6.92	100	86,250	se.	43	ne.	132	108	125	5.4	0.1
Palestine, Tex	515	29.47	30.01	−.03	65.6	+0.4	106	76	— 6	56	112	54	73	47.71	+ 1.20	93	63,560	s.	36	s.	142	109	114	5.1	7.8
San Antonio, Tex	701	29.25	29.98	−.02	68.6	+0.1	101	79	4	58	97	54	68	19.65	−10.05	60	82,007	se.	45	*	193	75	97	4.2	2.7
Ohio Valley and Tenn.					56.6	+0.5							71	38.05	— 7.23								5.3	
Chattanooga, Tenn	762	29.28	30.09	+.02	60.4	+0.5	98	70	−10	51	108	48	70	54.18	+ 1.28	136	59,757	sw.	50	sw.	121	152	92	5.1	3.6
Knoxville, Tenn	1,004	29.02	30.08	.00	58.3	+1.1	99	68	−10	49	109	47	74	34.41	−16.58	136	60,647	ne.	60	w.	157	112	96	4.7	15.3
Memphis, Tenn	397	29.63	30.06	+.02	61.5	+0.4	97	70	— 9	53	106	49	69	38.99	−14.29	108	74,663	sw.	48	*	129	122	114	5.2	12.3
Nashville, Tenn	546	29.50	30.09	+.05	59.2	−0.1	98	69	−13	50	111	48	71	44.44	— 5.66	118	59,878	nw.	44	s.	130	107	128	5.2	19.3
Louisville, Ky	525	29.49	30.06	+.01	57.1	+0.4	102	66	−14	48	116	45	70	37.86	— 7.90	129	68,771	s.	50	n.	127	85	153	5.6	25.3
Evansville, Ind	434	.....	.....	.....	57.0	.....	98	65	−15	49	113	.....	.....	42.55	.....	120	64,494	s.	38	sw.	158	110	97	4.5	19.3
Indianapolis, Ind	822	29.17	30.06	+.02	52.8	+0.1	98	62	−18	44	116	42	70	36.87	— 6.09	122	89,944	s.	46	*	98	130	137	5.8	23.2
Cincinnati, Ohio	628	29.39	30.07	+.02	55.0	−0.1	99	64	−17	46	116	43	69	34.69	— 5.18	125	66,901	sw.	48	sw.	148	109	108	4.9	24.9
Columbus, Ohio	824	29.17	30.06	+.02	53.2	+1.1	98	63	−20	44	118	43	74	28.45	−10.44	130	67,993	sw.	48	sw.	128	125	112	5.2	18.6
Pittsburg, Pa	842	29.15	30.05	+.01	53.6	+0.7	96	63	−20	45	116	43	73	33.85	— 2.83	140	49,591	nw.	37	nw.	118	137	110	5.4	48.7
Parkersburg, W. Va	638	29.40	30.09	+.02	54.6	+1.3	98	65	−27	44	125	44	74	36.77	— 5.20	131	49,355	s.	42	nw.	119	111	135	5.6	37.6
Elkins, W. Va	1,940	.....	.....	.....	49.9	.....	91	62	−21	38	112	.....	.....	47.35	.....	158	39,638	n.	35	w.	71	131	163	6.3	.....
Lower Lake Region.					49.0	+0.3							72	38.49	— 6.96								5.9	
Buffalo, N. Y	767	29.19	30.02	+.01	48.3	+1.8	91	55	— 8	42	99	40	74	29.39	— 8.65	137	121,879	w.	72	w.	58	157	150	6.7	69.8
Oswego, N. Y	335	29.66	30.03	+.01	46.8	+0.4	94	54	— 7	40	101	38	73	34.65	— 0.37	159	93,315	se.	48	w.	102	111	152	6.0	87.0
Rochester, N. Y	523	29.46	30.03	+.02	48.5	+1.7	94	57	— 7	40	111	37	80	26.76	— 8.06	165	67,950	sw.	42	*	134	100	131	5.5	96.0
Erie, Pa	713	29.28	30.05	+.04	49.1	+0.4	91	56	−12	42	103	41	76	28.36	−12.92	135	95,654	sw.	52	s.	87	130	148	6.1	48.2
Cleveland, Ohio	762	29.22	30.04	+.03	49.8	+0.9	92	57	−16	43	108	40	70	24.53	−11.76	131	124,561	se.	58	*	101	150	114	5.5	38.8
Sandusky, Ohio	629	29.36	30.04	.00	50.6	+0.6	96	58	−15	43	111	40	72	30.78	— 4.13	137	72,898	sw.	56	nw.	91	85	189	6.5	22.2
Toledo, Ohio	628	29.36	30.04	+.02	50.0	+0.4	95	58	−15	42	110	39	71	27.06	— 3.87	126	85,509	sw.	44	nw.	129	118	118	5.4	31.7
Detroit, Mich	730	29.24	30.03	+.01	48.6	+0.5	95	56	−13	41	108	39	73	26.41	— 5.92	117	85,559	sw.	50	sw.	103	135	127	5.7	60.2
Upper Lake Region.					43.4	+0.6							79	28.13	— 4.41								5.9	
Alpena, Mich	609	29.35	30.03	+.02	42.1	+0.8	93	50	−20	34	113	36	81	29.93	— 5.15	140	79,787	nw.	42	sw.	100	129	136	5.9	46.7
Escanaba, Mich	612	29.34	30.02	+.03	40.3	+0.1	89	48	−29	32	118	34	82	25.36	— 7.30	116	77,106	n.	40	n.	95	120	150	6.1	41.7
Grand Haven, Mich	632	29.33	30.02	+.02	46.7	+0.4	93	55	−25	39	118	39	80	27.98	— 6.79	134	86,173	nw.	52	sw.	104	121	140	5.8	54.2
Marquette, Mich	734	29.17	29.98	−.02	40.6	+0.1	91	48	−23	34	114	34	83	36.43	+ 4.06	162	85,713	nw.	45	se.	68	124	173	6.7	85.7
Port Huron, Mich	638	29.35	30.05	+.04	46.9	+1.7	97	55	−15	39	112	39	79	25.85	— 5.75	123	96,640	s.	50	sw.	122	118	125	5.5	45.6
Sault Ste. Marie, Mich.	614	29.32	30.00	.00	38.7	−0.3	87	48	−37	30	124	33	86	30.68	+ 1.15	135	77,126	e.	44	nw.	98	109	158	6.2	61.3
Chicago, Ill	823	29.15	30.04	+.02	49.0	+0.7	98	56	−21	42	119	41	77	26.49	— 8.27	110	148,139	ne.	60	s.	127	123	115	5.3	18.0
Milwaukee, Wis	681	29.29	30.03	+.01	46.8	+1.8	93	54	−22	39	115	37	72	22.82	— 9.24	112	95,955	w.	43	sw.	88	96	181	6.2	36.1
Green Bay, Wis	617	29.34	30.02	+.02	44.1	+0.7	93	53	−33	35	126	36	76	25.76	— 6.54	110	71,244	s.	39	sw.	130	130	115	5.4	48.3
Duluth, Minn	702	29.23	30.01	+.01	39.0	−0.3	87	46	−36	32	123	30	76	30.62	+ 0.39	122	87,210	ne.	48	nw.	115	125	125	5.5	38.9
North Dakota.					38.2	−0.5							73	16.24	— 2.71								4.6	
Moorhead, Minn	935	28.98	30.03	+.01	39.2	+1.6	96	49	−36	29	132	31	79	20.64	— 3.13	98	90,658	nw.	47	se.	145	101	119	5.0	33.8
Bismarck, N. Dak	1,674	28.21	30.03	+.02	38.6	−1.0	100	50	−37	27	137	27	68	15.47	— 2.91	82	83,986	nw.	56	nw.	185	101	79	4.5	35.8
Williston, N. Dak	1,875	27.98	30.02	+.02	36.7	−2.2	94	48	−41	25	135	27	72	12.61	— 2.09	86	83,829	n.	60	*	212	101	52	4.4	35.1
Upper Mississippi Val.					50.1	+0.5							72	33.13	— 1.51								5.2	
Minneapolis, Minn	.....	.....	.....	.....	44.4	+0.1	96	53	−33	36	129	....	.....	24.93	— 2.28	106	97,766	nw.	48	e.	93	140	132	.....	62.4
St. Paul, Minn	837	29.08	30.01	.00	44.2	+0.9	96	53	−33	36	129	34	72	27.54	+ 0.07	120	68,832	nw.	48	nw	127	131	107	5.2	59.4
La Crosse, Wis	714	.....	.....	.....	45.6	−0.4	94	55	−32	36	126	.....	.....	35.35	+ 4.67	105	59,861	se.	42	w.	127	128	110	5.3	45.5
Davenport, Iowa	606	29.36	30.02	−.01	50.3	+1.1	99	59	−23	41	122	40	73	31.64	— 2.08	106	67,980	sw.	37	sw.	131	95	139	5.4	22.2

TABLE I.—*Annual climatological summary, Weather Bureau stations,* 1899—Continued.

Districts and stations.	Elevation of barometer above sea-level.	Pressure, in inches.†			Temperature of the air, in degrees Fahrenheit.							Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation.			Winds.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall, in inches.‡
		Mean actual, 8 a. m. + 8 p. m. ÷ 2.	Mean reduced.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Mean maximum.	Minimum.	Mean minimum.	Annual range.			Total, in inches.	Departure from normal.	Days with .01 or more.	Total movement, miles.	Prevailing direction.	Max. velocity. Miles per hour.	Max. velocity. Direction.					
Upper Miss. Val.—Con.																									
Des Moines, Iowa	861	29.10	30.04	+.02	49.3	+0.8	99	59	−24	39	123	38	73	26.73	− 6.38	94	73,171	sw.	42	sw.	116	151	98	5.2	29.5
Dubuque, Iowa	698	29.27	30.03	+.01	48.1	+0.5	96	58	−26	39	122	37	72	28.28	− 7.25	100	67,289	nw.	42	nw.	142	137	86	4.7	23.3
Keokuk, Iowa	614	29.38	30.04	+.02	52.3	+0.9	99	61	−21	44	120	41	72	40.97	+ 6.25	105	68,061	sw.	48	w.	159	113	93	4.4	23.9
Cairo, Ill	356	29.67	30.06	+.02	57.8	+0.1	97	66	−14	50	111	48	76	42.42	− 0.41	115	73,772	s.	54	w.	99	150	116	5.4	18.1
Springfield, Ill	644	29.35	30.05	+.01	52.5	+0.2	99	61	−21	44	120	42	73	38.80	+ 0.79	113	81,753	s.	41	w.	100	118	147	5.8	17.3
St. Louis, Mo	567	29.43	30.04	.00	56.6	+1.0	102	65	−16	48	118	44	69	34.61	− 6.47	120	84,070	s.	60	sw.	132	111	122	5.1	28.1
Missouri Valley.					49.9	+0.3							70	35.44	− 4.81									4.9	
Columbia, Mo	784	.....	.....	.....	53.8	−0.6	103	65	−26	42	129	.....	.....	34.81	− 5.12	121	71,868	se.	51	sw.	116	126	123	5.5	27.9
Kansas City, Mo	963	29.00	30.03	+.01	54.2	+1.0	100	63	−22	45	122	42	69	32.52	− 3.82	101	78,198	se.	44	nw.	136	112	117	4.9	38.6
Springfield, Mo	1,324	28.62	30.02	−.01	55.4	+0.5	99	64	−29	46	128	45	74	34.21	−11.51	107	93,115	se.	57	sw.	171	109	85	4.5	16.5
Topeka, Kans	.....	.....	.....	.....	53.8	0.0	100	64	−25	44	125	.....	.....	27.69	− 6.71	106	.....	s.	.....	.....	114	168	83	4.8	39.6
Lincoln, Nebr	1,189	28.72	30.00	−.03	50.2	+0.1	101	61	−26	39	127	38	70	22.53	− 3.78	85	96,192	s.	48	*	151	128	86	4.7	31.4
Omaha, Nebr	1,105	28.82	30.00	−.05	50.2	+0.6	99	60	−26	41	125	39	73	26.74	− 4.95	89	74,626	se.	42	ne.	117	135	113	5.4	33.5
Sioux City, Iowa	1,135	.....	.....	.....	47.0	0.0	99	57	−31	37	130	.....	.....	22.67	− 1.83	84	111,147	nw.	60	s.	142	107	116	4.9	24.5
Pierre, S. Dak	1,572	28.31	30.00	−.03	44.6	−0.8	106	56	−39	33	145	28	60	20.00	+ 4.23	106	95,500	nw.	61	nw.	139	121	105	4.9	36.8
Huron, S. Dak	1,306	28.59	30.02	−.02	43.1	+0.8	104	56	−37	30	141	31	72	13.66	− 7.37	96	103,390	nw.	56	nw.	156	133	76	4.6	26.3
Yankton, S. Dak	1,233	.....	.....	.....	46.9	+1.1	98	58	−30	36	128	.....	.....	19.54	− 7.28	98	79,688	nw.	47	s.	120	157	88	5.1	34.5
Northern Slope.					43.4	−1.2							61	13.68	− 0.74									5.0	
Miles City, Mont	2,371	27.44	29.97	−.05	42.4	−1.8	101	54	−49	31	150	32	77	15.24	+ 2.53	94	56,838	w.	62	n.	158	135	72	4.5	51.8
Helena, Mont	4,110	25.81	30.05	+.02	41.4	−1.7	98	51	−30	32	128	24	56	11.78	− 1.40	106	67,448	sw.	44	sw.	90	116	159	5.9	73.5
Rapid City, S. Dak	3,234	26.56	29.94	−.07	44.4	−1.6	102	56	−34	33	136	29	64	16.71	0.00	103	61,104	nw.	42	*	161	119	85	4.6	21.7
Cheyenne, Wyo	6,088	23.96	29.99	−.02	43.2	−1.2	93	56	−28	30	121	21	49	14.18	+ 1.98	100	100,561	nw.	60	w.	113	144	108	5.3	77.6
Lander, Wyo	5,372	24.60	30.02	−.01	41.2	−1.0	93	56	−35	26	128	21	55	10.15	− 3.30	53	40,906	sw.	52	w.	117	181	67	4.8	63.6
North Platte, Nebr	2,821	27.05	30.01	−.01	47.8	−0.1	101	61	−35	35	136	33	66	13.99	− 4.28	77	79,614	nw.	48	se.	159	144	62	4.6	22.5
Middle Slope.					53.4	+0.1							63	26.44	+ 4.11									4.2	
Denver, Colo	5,291	24.69	30.01	+.02	48.8	−0.6	97	63	−22	35	119	24	48	9.33	− 5.16	74	73,467	s.	51	nw.	205	109	51	3.7	72.0
Pueblo, Colo	4,685	25.25	29.97	−.01	50.3	−0.8	100	65	−27	36	127	27	51	13.05	+ 0.94	64	64,086	nw.	54	nw.	181	138	46	4.0	33.8
Concordia, Kans	1,398	28.52	30.01	−.03	53.1	+0.9	102	64	−25	42	127	40	71	30.66	+ 5.17	86	66,303	s.	38	s.	146	134	85	4.8	35.5
Dodge, Kans	2,509	27.37	29.98	.00	54.2	+1.1	102	67	−26	41	128	39	67	28.45	+ 8.61	80	100,872	se.	61	sw.	175	131	59	4.4	22.2
Wichita, Kans	1,358	28.57	30.00	.00	55.6	+0.2	104	66	−22	45	126	43	70	33.49	+ 4.72	86	81,565	s.	45	n.	156	116	93	4.5	24.2
Oklahoma, Okla	1,214	28.71	30.00	.00	58.7	−0.3	102	69	−17	48	119	46	69	43.66	+10.37	84	94,659	s.	60	nw.	212	72	81	3.7	5.9
Southern Slope.					59.4	+0.3							62	25.40	+ 3.80									3.7	
Abilene, Tex	1,738	28.17	29.98	−.03	63.8	+0.4	104	75	− 6	53	110	46	61	23.41	− 1.61	56	91,006	se.	51	se.	170	127	68	4.0	8.2
Amarillo, Tex	3,676	26.22	29.96	−.04	55.0	+0.2	97	67	−16	43	113	38	62	27.39	+ 9.20	66	123,194	s.	72	n.	205	98	62	3.4	21.1
Southern Plateau.					62.5	+0.2							36	5.18	− 2.72									2.4	
El Paso, Tex	3,762	26.15	29.93	−.02	63.3	−0.1	100	77	5	50	95	27	35	7.30	− 2.03	40	97,778	nw.	62	w.	210	121	34	3.0	3.3
Santa Fe, N. Mex	7,013	23.25	29.97	−.02	49.0	+0.7	87	59	− 5	38	92	20	41	10.05	− 4.20	81	59,693	se.	43	sw.	234	99	32	3.0	19.0
Phenix, Ariz	1,108	28.76	29.91	−.03	69.7	+0.6	112	84	24	56	88	37	36	5.19	− 2.02	32	38,841	e.	32	e.	245	86	34	2.7	T.
Yuma, Ariz	141	29.71	29.85	−.04	71.8	−0.4	112	86	28	57	84	40	39	0.60	− 2.37	5	59,409	w.	48	w.	301	52	12	1.4	0.0
Independence, Cal	3,910	25.95	29.89	−.05	58.9	+0.3	100	71	11	46	89	19	27	2.75	− 2.98	26	79,547	nw.	54	nw.	284	72	9	1.8	9.2
Middle Plateau.					49.3	−0.5							49	11.23	− 0.99									4.6	
Carson City, Nev	4,720	25.27	30.02	+.03	49.9	+0.3	93	62	− 4	36	99	27	50	7.64	− 4.33	50	63,317	w.	70	w.	155	118	92	4.4	34.6
Winnemucca, Nev	4,344	25.66	30.04	+.04	47.3	−1.3	98	60	−12	34	110	25	53	8.47	− 0.01	73	85,485	sw.	75	w.	127	97	141	5.4	44.9
Salt Lake City, Utah	4,366	25.62	30.04	+.01	50.8	−0.5	97	61	−10	41	107	27	47	17.57	+ 1.38	95	51,193	se.	56	w.	150	120	95	4.6	72.5
Grand Junction, Colo	4,608	25.36	30.01	.....	51.0	.....	98	64	−12	38	110	24	46	10.87	.....	62	47,195	nw.	39	s.	155	140	70	4.2	21.6
Northern Plateau.					49.9	−0.7							64	19.29	+2.81									5.4	
Boise, Idaho	2,739	27.17	30.03	−.01	50.0	−0.7	102	61	− 9	39	111	35	62	14.81	+0.39	104	41,913	w.	36	*	133	116	116	5.1	35.1
Pocatello, Idaho	4,482	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Spokane, Wash	1,943	27.94	30.00	−.02	47.2	−0.6	98	57	−21	38	119	33	65	20.08	+1.83	134	56,410	s.	36	s.	90	112	163	6.3	56.4
Walla Walla, Wash	1,000	28.93	30.00	−.04	52.4	−0.8	102	62	− 6	43	108	39	66	22.99	+6.22	129	54,072	s.	32	sw.	132	164	69	4.8	34.9
North Pacific Coast.					50.4	−0.1							70	44.54	+2.47									6.5	
Port Cresent, Wash	239	.....	.....	.....	46.4	−0.2	89	53	9	40	90	.....	.....	49.51	+3.23	198	38,320	w.	48	se.	60	147	158	6.5	51.5
Seattle, Wash	123	29.90	30.03	.00	51.3	+0.4	90	58	12	45	78	43	77	37.13	−0.31	181	52,432	se.	34	sw.	59	119	187	6.8	37.0
Tacoma, Wash	213	.....	.....	.....	50.3	+0.5	89	57	9	44	80	.....	.....	50.88	+6.25	184	55,943	sw.	39	*	75	70	220	7.0	29.5
Portland, Oreg	154	29.88	30.04	−.02	51.8	−0.7	93	59	9	45	84	43	75	42.21	−4.62	165	73,457	nw.	48	s.	74	114	177	6.4	23.8
Roseburg, Oreg	518	29.47	30.04	−.03	52.4	−0.3	93	62	7	43	86	43	75	42.97	+7.81	161	32,343	ne.	30	*	106	106	153	5.9	20.8
Middle Pacific Coast.					56.0	−0.4							71	31.55	+2.13									4.8	
Eureka, Cal	62	30.03	30.09	+.04	50.9	−0.5	76	56	24	46	52	46	84	51.88	+6.05	130	55,970	nw.	39	se.	91	122	152	5.9	T.
Red Bluff, Cal	332	29.63	29.98	−.01	62.4	−0.1	109	73	26	51	83	40	55	28.79	+2.68	79	59,380	se.	42	se.	219	74	72	3.5	0.0
Sacramento, Cal	69	29.91	29.99	.00	59.6	−0.2	102	71	30	49	72	44	63	21.14	+0.27	64	78,450	sw.	48	se.	201	76	88	4.2	T.
San Francisco, Cal	155	29.87	30.03	+.02	54.9	−0.9	94	61	34	49	60	48	83	23.23	−0.48	67	96,602	w.	47	sw.	185	104	76	4.0	0.0
Point Reyes Light, Cal	.....	.....	.....	.....	52.0	−0.2	86	57	33	47	53	.....	.....	32.71	+2.15	89	159,867	nw.	76	nw.	116	49	200	6.2	0.0
South Pacific Coast.					60.8	−0.2							68	12.92	−1.66									3.4	
Fresno, Cal	330	29.62	29.97	.00	62.6	−0.4	111	68	24	50	87	42	58	10.54	+1.54	52	48,242	nw.	32	sw.	226	56	83	3.4	0.0
Los Angeles, Cal	338	29.61	29.96	.00	61.9	+0.5	100	73	33	51	67	49	73	8.69	−8.61	31	32,721	w.	30	e.	162	167	36	3.8	0.0
San Diego, Cal	87	29.87	29.97	−.01	60.1	−0.6	93	66	34	55	59	50	73	6.08	−4.43	33	50,428	nw.	33	se.	280	40	44	2.9	0.0
San Luis Obispo, Cal	201	29.81	30.03	+.04	58.4	−0.3	99	70	25	46	74	46	70	26.39	+4.87	47	45,157	n.	32	se.	208	95	62	3.7	0.0
West Indies.																									
Basseterre, St. Kitts	29	29.96	29.99	.....	78.7	.....	89	84	64	74	25	70	75	39.07	.....	185	86,723	e.	72	ne.	68	223	74	5.5	0.0
Bridgetown, Bar	30	29.92	29.95	.....	79.3	.....	90	85	68	74	32	71	79	38.53	.....	196	72,206	e.	28	*	14	232	119	6.5	0.0
Port of Spain, Trin	40	29.88	29.92	.....	79.3	.....	92	87	66	72	26	71	77	45.86	.....	160	40,161	e.	20	e.	92	207	66	5.4	0.0
San Juan, Puerto Rico	82	29.91	29.99	.....	77.8	.....	91	84	65	72	26	71	80	77.61	.....	208	66,558	e.	66	e.	173	146	46	4.2	0.0
Santiago de Cuba	82	29.86	29.94	.....	78.9	.....	96	87	61	71	35	69	77	54.78	.....	126	44,653	ne.	30	se.	126	192	47	4.7	0.0
Santo Domingo, S. D	57	29.94	30.00	.....	76.6	.....	92	84	61	69	31	70	84	79.06	.....	166	41,767	n.	40	se.	150	160	55	4.3	0.0
Willemstad, Curaçao	75	29.82	29.89	.....	80.7	.....	94	85	67	76	27	72	77	16.17	.....	110	104,654	e.	29	e.	114	203	48	4.8	0.0

*Two or more directions. †Reduced to standard gravity. ‡For the snow year, July 1, 1898, to June 30, 1899.

TABLE II.—*Annual climatological summary, Canadian stations*, 1899.

Stations.	Pressure.* Mean not reduced.	Pressure.* Mean reduced.	Pressure.* Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Total depth of snowfall.†
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Inches.*	*Ins.*
St. Johns, N. F	29.72	29.87	—.06	39.5	—1.0	46.3	32.7	44.55	.. ....	55.7
Sydney, C. B. I.	29.92	29.96	+.03	41.9	+0.6	50.4	33.4	46.99	— 5.35	81.0
Halifax, N. S	29.88	29.99	+.03	44.6	+1.8	53.3	36.2	53.06	— 2.38	76.5
Grand Manan, N. B.	29.95	30.00	+.02	43.5	+0.7	50.6	36.3	42.22	— 2.40	83.8
Yarmouth, N. S	29.93	30.01	+.03	44.0	+0.8	51.0	36.8	48.63	+ 2.50	90.7
Charlottetown, P. E. I.	29.92	29.96	+.01	42.4	+1.4	50.3	34.6	40.13	— 1.65	100.7
Chatham, N. B.	29.95	29.97	+.01	40.0	+1.3	50.1	30.0	34.73	— 9.23	122.4
Father Point, Que.	29.94	29.97	+.02	35.3	+0.5	44.1	26.6	31.75	+ 1.95	107.4
Quebec, Que.	29.66	30.00	+.02	40.0	+1.8	48.0	31.9	36.88	— 5.90	121.3
Montreal, Que	29.79	30.00	+.02	43.2	+1.7	50.8	35.6	41.85	+ 3.04	116.4
Bissett, Ont.	29.40	30.03	+.05	38.4	+0.8	50.7	26.2	29.79	— 1.26	78.0
Ottawa, Ont	29.67	29.99	.....	42.4	+1.8	51.6	33.3	38.05	.....	103.7
Kingston, Ont	29.65	29.97	—.01	44.4	+1.3	52.5	36.4	27.52	— 6.42	45.7
Toronto, Ont	29.65	30.03	+.01	46.4	+2.2	55.1	37.6	28.94	— 1.81	53.9
White River, Ont.	28.64	30.03	.00	31.8	—0.1	44.7	18.8	25.79	+ 2.20	84.9
Port Stanley, Ont	29.39	30.03	+.01	45.8	+1.1	54.2	37.5	30.61	— 3.56	64.7
Saugeen, Ont	29.30	30.03	+.03	43.7	+1.3	52.1	35.2	32.05	— 2.03	137.9
Parry Sound, Ont.	29.31	30.02	+.02	41.4	+1.2	51.6	31.2	43.99	+ 6.67	173.1
Port Arthur, Ont	29.27	29.99	—.01	35.0	+0.6	44.8	25.2	26.53	+ 2.49	18.1
Winnipeg, Man	29.14	29.99	—.03	34.2	+1.3	45.4	23.0	19.82	— 3.63	60 1
Minnedosa, Man.	28.13	29.99	—.01	32.5	+0.9	43.9	21.1	15.82	— 1.91	30.5
Qu'Appelle, Assin	27.66	29.97	—.03	32.1	—1.2	42.2	21.9	19.27	+ 4.33	92.1
Medicine Hat, Assin.	27.64	29.99	+.01	38.9	—1.4	50.5	27.4	.....	.....	73.9
Swift Current, Assin	27.37	30.00	—.01	35.5	—2.0	45.7	25.3	19.38	+ 3.53	37.9
Calgary, Alberta	26.35	29.95	—.04	34.7	—2.5	46.1	23.3	26.15	+12.87	35.6
Banff, Alberta	25.28	29.99	.. ....	34.0	.....	44.2	23.7	26.34	.....	87.2
Edmonton, Alberta	27.59	29.94	—.04	34.6	—1.0	45.1	24.0	20.89	+ 7.08	44.2
Prince Albert, Sask	28.35	29.94	.....	30.5	0.0	41.4	19.6	29.88	.....	68.2
Battleford, Sask.	28.21	29.99	.....	33.3	+0.6	42.8	21.9	18.42	.... ..	37.8
Hamilton, Bermuda	29.93	30.09	+.03	69.8	+0.1	74.8	64.9	57.97	.....	0.0

* Reduced to standard gravity. † For the snow year, July 1, 1898, to June 30, 1899.

TABLE III.—*Reduction data for* 1899.

Stations.	Elevation.	Latitude.	Mean observed pressure.	Mean observed temperature.	Mean dew-point.	Mean reduction temperature.	Mean pressure reduced to sea level.	Mean temperature reduced to sea level.	Mean pressure at 10,000 feet altitude.
1	2	3	4	5	6	7	8	9	10
New England States.	*Feet.*	° ′	*Inches.*	° F.	° F.	° F.	*Inches.*	° F.	*Ins.*
Eastport, Me.	76	44 54	29.92	42.1	35	42.2	30.00	42.3	20.53
Portland, Me.	103	43 39	29.89	45.7	36	45.8	30.00	45.9	20.59
Northfield, Vt.	876	44 10	29.08	41.4	34	43.3	30.04	44.2	20.56
Boston, Mass.	125	42 21	29.90	50.2	39	50.3	30.04	50.2	20.68
Nantucket, Mass.	12	41 17	30.03	49.4	43	49.4	30.05	49.4	20.67
Block Island, R. I.	26	41 10	30.02	49.2	42	49.2	30.05	49.2	20.67
New Haven, Conn.	106	41 18	29.93	49.6	41	49.7	30.05	49.8	20.69
Middle Atlantic States.									
Albany, N. Y.	97	42 39	29.93	49.0	40	49.1	30.06	49.2	20.67
New York, N. Y.	314	40 43	29.72	52.6	43	52.9	30.06	53.2	20.74
Philadelphia, Pa.	117	39 57	29.93	54.5	43	54.6	30.08	54.7	20.78
Atlantic City, N. J.	52	39 22	30.01	51.8	46	52.3	30.07	52.4	20.73
Baltimore, Md.	123	39 18	29.93	55.0	44	55.1	30.06	55.2	20.78
Washington, D. C.	112	38 54	29.96	54.4	44	54.5	30.08	54.6	20.78
Lynchburg, Va.	672	37 25	29.33	56.5	46	57.2	30.06	57.9	20.81
Norfolk, Va.	91	36 51	29.98	59.4	51	59.5	30.04	59.6	20.85
South Atlantic States.									
Charlotte, N. C.	773	35 13	29.25	59.8	47	60.6	30.07	61.4	20.87
Hatteras, N. C.	11	35 15	30.06	62.2	56	62.2	30.07	62.2	20.89
Raleigh, N. C.	376	35 45	29.68	59.5	50	59.9	30.08	60.3	20.87
Wilmington, N. C.	78	34 14	30.00	62.6	54	62.7	30.08	62.8	20.92
Charleston, S. C.	48	32 47	30.05	66.6	56	66.7	30.10	66.8	20.99
Augusta, Ga.	180	33 28	29.88	64.2	52	64.4	30.07	64.6	20.94
Savannah, Ga.	65	32 5	30.00	67.0	56	67.1	30.07	67.2	20.97
Jacksonville, Fla.	43	30 20	30.02	69.4	61	69.4	30.06	69.4	21.01
Florida Peninsula.									
Jupiter, Fla.	28	26 57	30.00	74.4	66	74.4	30.03	74.4	21.05
Key West, Fla.	22	24 34	30.01	76.9	69	76.9	30.03	76.9	21.09
Tampa, Fla.	34	27 57	30.00	71.5	64	71.5	30.04	71.5	21.02
Eastern Gulf States.									
Atlanta, Ga.	1,174	33 45	28.84	61.6	49	62.7	30.07	63.8	20.91
Mobile, Ala.	57	30 41	30.00	66.5	59	66.6	30.06	66.7	20.96
Montgomery, Ala.	223	32 23	29.82	65.5	54	65.7	30.06	65.9	20.94
Vicksburg, Miss.	247	32 22	29.76	65.3	55	65.6	30.01	65.9	20.91
New Orleans, La.	51	29 58	29.99	68.8	59	68.9	30.05	69.0	20.99
West Gulf States.									
Shreveport, La.	249	32 30	29.76	65.8	51	66.0	30.02	66.2	20.92
Fort Smith, Ark	457	35 22	29.52	61.2	48	61.7	30.00	62.2	20.84
Little Rock, Ark.	357	34 45	29.67	61.0	50	61.3	30.05	61.6	20.86
Corpus Christi, Tex.	18	27 49	29.97	69.9	63	70.8	29.99	70.8	20.98
Galveston, Tex.	54	29 18	29.95	69.2	61	69.2	30.01	69.2	20.96
Palestine, Tex.	515	31 45	29.47	65.6	54	66.1	30.01	66.6	20.91
San Antonio, Tex.	701	29 27	29.25	68.6	54	69.3	29.98	70.0	20.95
Ohio Valley and Tennessee.									
Chattanooga, Tenn.	762	35 4	29.28	60.4	48	61.2	30.09	62.0	20.90
Knoxville, Tenn.	1,004	35 56	29.02	58.3	47	59.3	30.08	60.3	20.86
Memphis, Tenn.	397	35 9	29.63	61.5	49	61.9	30.06	62.3	20.88
Nashville, Tenn	546	36 10	29.50	59.2	48	59.2	30.08	60.2	20.86

TABLE III.—*Reduction data for* 1899—Continued.

Stations.	Elevation.	Latitude.	Mean observed pressure.	Mean observed temperature.	Mean dew-point.	Mean reduction temperature.	Mean pressure reduced to sea level.	Mean temperature reduced to sea level.	Mean pressure at 10,000 feet altitude.
1	2	3	4	5	6	7	8	9	10
Ohio Val. and Ten.—Con.	*Feet.*	° ′	*Inches.*	° F.	° F.	° F.	*Inches.*	° F.	*Ins.*
Louisville, Ky.	525	38 15	29.49	57.1	45	57.6	30.05	58.1	20.81
Indianapolis, Ind.	822	39 46	29.17	52.8	42	53.6	30 06	54.3	20.75
Cincinnati, Ohio	628	39 6	29.39	55.0	43	55.6	30.07	56.2	20.79
Columbus, Ohio	824	39 58	29.17	53.2	43	54.0	30.06	54.8	20.75
Pittsburg, Pa.	842	40 32	29.15	53.6	43	54.4	30.06	55.2	20.76
Parkersburg, W. Va.	638	39 16	29.40	54.6	44	55.2	30.09	55.8	20.79
Lower Lake Region.									
Buffalo, N. Y.	767	42 53	29.19	48.3	40	49.0	30.02	49.7	20.65
Oswego, N. Y.	335	43 29	29.66	46.8	38	47.1	30.03	47.4	20.62
Rochester, N. Y.	523	43 8	29.46	48.5	37	49.0	30.03	49.5	20.65
Erie, Pa.	713	42 7	29.28	49.1	41	49.8	30.06	50.5	20.69
Cleveland, Ohio	762	41 30	29.22	49.8	40	50.5	30.04	51.2	20.70
Sandusky, Ohio	629	41 25	29.36	50.6	40	51.2	30.04	51.8	20.70
Toledo, Ohio	628	41 40	29.36	50.0	39	50.7	30.04	51.4	20.70
Detroit, Mich.	730	42 20	29.24	48.6	39	49.3	30.03	50.0	20.66
Upper Lake Region.									
Alpena, Mich.	609	45 5	29.35	42.0	36	42.6	30.02	43.2	20.55
Escanaba, Mich.	612	45 48	29.34	40.3	34	40.9	30.02	41.5	20.55
Grand Haven, Mich.	632	43 5	29.33	46.7	39	47.3	30.02	47.9	20.62
Marquette, Mich.	734	46 34	29.17	40.6	34	41.3	29.98	42.0	20.49
Port Huron, Mich.	638	43 0	29.35	46.9	39	47.5	30.05	48.1	20.65
Sault Ste. Marie, Mich.	614	46 30	29.32	38.7	33	39.3	30.00	39.9	20.47
Chicago, Ill.	823	41 53	29.15	49.0	41	49.8	30.05	50.6	20.68
Milwaukee, Wis.	681	43 2	29.29	46.8	37	47.5	30.03	48.2	20.63
Green Bay, Wis.	617	44 31	29.34	44.1	35	44.7	30.02	45.3	20.58
Duluth, Minn.	702	46 47	29.23	39.0	30	39.7	30.01	40.4	20.49
North Dakota.									
Moorhead, Minn	935	46 52	28.98	39.2	31	40.1	30.01	41.0	20.50
Bismarck, N. Dak.	1,674	46 47	28.21	38.6	27	40.0	30.03	41.7	20.51
Williston, N. Dak.	1,875	48 9	27.98	36.7	27	37.7	30.02	39.6	20.46
Upper Mississippi Valley.									
St. Paul, Minn	837	44 58	29.08	44.2	34	45.0	30.00	45.9	20.56
Davenport, Iowa	606	41 30	29.36	50.3	40	50.9	30.01	51.5	20.67
Des Moines, Iowa	861	41 35	29.10	49.3	38	50.2	30.04	51.1	20.68
Dubuque, Iowa	698	42 30	29.27	48.1	37	48.8	30.03	49.5	20.65
Keokuk, Iowa	614	40 22	29.38	52.3	41	52.9	30.04	53.5	20.73
Cairo, Ill	356	37 0	29.67	57.8	48	58.2	30.05	58.6	20.81
Springfield, Ill.	644	39 48	29.35	52.5	42	53.1	30.05	53.7	20.73
St. Louis, Mo.	567	38 38	29.43	56.6	44	57.2	30.04	57.8	20.79
Missouri Valley.									
Kansas City, Mo.	963	39 5	29.00	54.2	42	55.2	30.03	56.2	20.75
Springfield, Mo.	1,324	37 12	28.62	55.4	45	56.7	30.02	58.0	20.78
Lincoln, Nebr.	1,189	40 49	28.72	50.2	38	51.9	30.00	53.1	20.68
Omaha, Nebr.	1,105	41 16	28.82	50.2	39	51.3	30.01	52.4	20.67
Pierre, S. Dak.	1,572	44 22	28.31	44.6	28	44.7	30.01	46.2	20.57
Huron, S. Dak.	1,306	44 21	28.59	43.1	31	45.7	30.00	47.0	20.59
Northern Slope.									
Havre, Mont.	2,503	48 34	27.31	39.2	28	40.1	30.00	43.6	20.49
Miles City, Mont	2,371	46 25	27.44	42.4	32	43.3	29.96	46.6	20.51
Helena, Mont.	4,110	46 34	25.81	41.4	24	45.4	30.03	49.5	20.60
Rapid City, S. Dak.	3,234	44 4	26.56	44.4	29	45 4	29.95	48.7	20.53
Cheyenne, Wyo.	6,088	41 8	23.96	43.2	21	48.5	29.97	54.6	20.60
Lander, Wyo.	5,372	42 50	24.60	41.2	21	46.2	30.00	51.6	20.59
North Platte, Nebr.	2,821	41 8	27.05	47.8	33	50.5	30.00	53.3	20.65
Middle Slope.									
Denver, Colo	5,291	39 45	24.69	48.8	24	52.0	29.95	57.3	20.65
Pueblo, Colo	4,685	38 18	25.25	50.3	27	53.6	29.94	58.3	20.67
Concordia, Kans	1,398	39 35	28.52	53.1	40	55 0	30.00	56.4	20.73
Dodge, Kans.	2,509	37 45	27.37	54.2	39	57.0	29.96	59.5	20.74
Wichita, Kans.	1,358	37 41	28.57	55.6	43	57.3	30.00	58.7	20.76
Oklahoma, Okla.	1,214	35 26	28.71	58.7	46	59.6	29.99	60.8	20.80
Southern Slope.									
Abilene, Tex.	1,738	32 23	28.17	63.8	46	64.6	29.98	66.3	20.88
Amarillo, Tex.	3,676	35 13	26.22	55.0	38	58.4	29.94	62.1	20.75
Southern Plateau.									
El Paso, Tex.	3,762	31 47	26.15	63.3	27	65.5	29.92	69.3	20.85
Santa Fe, N. Mex.	7,013	35 41	23.35	49.0	20	56.3	29.95	63.3	20.72
Phenix, Ariz.	1,108	33 28	28.76	69.7	37	69.1	29.89	70 2	20.88
Yuma, Ariz.	141	32 45	29.71	71.8	40	70.5	29.86	70.6	20.87
Independence, Cal.	3,910	36 48	25.95	58.9	19	62.8	29.85	66.7	20.74
Middle Plateau.									
Carson City, Nev	4,720	39 10	23.27	49.9	27	54.6	30.00	59.3	20.73
Winnemucca, Nev.	4,344	40 58	23.66	47.3	25	53.3	30.06	58.8	20.74
Salt Lake City, Utah.	4,366	40 46	23.62	50.8	27	52.8	30.03	59.1	20.72
Grand Junction, Colo.	4,608	39 9	25.36	51.0	24	55.6	29.98	59.2	20.73
Northern Plateau.									
Baker City, Oreg	3,471	44 50	26.43	44.4	28	47.8	30.02	51.3	20.73
Boise, Idaho	2,739	43 37	27.17	50.0	35	51.7	30.03	54.7	20.70
Spokane, Wash.	1,943	47 40	27.94	47.2	33	48.7	30.00	50.6	20.64
Walla Walla Wash.	1,000	46 2	28.93	52.4	39	50.8	30.01	51.8	20.67
North Pacific Coast.									
Fort Canby, Wash.	180	46 16	.....	.....	....	.....	.....	.....	.....
Neah, Wash	50	48 22	29.97	47.9	....	47.9	30.02	47.9	20.63
Seattle, Wash	123	47 38	29.90	51.3	43	51.4	30.03	51.5	20.69
Portland, Oreg.	154	45 32	29.88	51.8	43	52.0	30.05	52.2	20.71
Roseburg, Oreg.	518	43 13	29.47	52.4	43	52.9	30.03	53.4	20.72
Middle Pacific Coast.									
Eureka, Cal.	62	40 48	30.03	50.9	46	53.1	30.10	53.2	20.77
Red Bluff, Cal.	332	40 10	29.63	62.4	40	56.2	29.99	56.5	20.74
Sacramento, Cal.	69	38 35	29.91	59.6	44	58.7	29.99	58.6	20.78
San Francisco, Cal.	155	37 48	29.87	54.9	48	55.1	30.04	55.3	20.76
South Pacific Coast.									
Fresno, Cal.	330	36 43	29.62	62.6	42	60.4	29.97	60.7	20.79
Los Angeles, Cal	338	34 3	29.61	61.9	49	61.9	29.96	62.2	20.81
San Diego, Cal.	87	32 43	29.87	60.1	50	62.6	29.96	62.7	20.83
San Luis Obispo, Cal.	201	35 18	29.81	58.4	46	58.6	30.02	58.8	20.81
Canadian Stations.									
St. Johns, N. F.	125	47 34	29.72	39.5	....	39.6	29.86	39.7	20.39
Sydney, C. B. I.	35	46 10	29.92	41.9	....	42.0	29.96	42.1	20.49

TABLE III.—*Reduction data for* 1899—Continued.

Stations.	Elevation.	Latitude.	Mean observed pressure.	Mean observed temperature.	Mean dew-point.	Mean reduction temperature.	Mean pressure reduced to sea level.	Mean temperature reduced to sea level.	Mean pressure at 10,000 feet altitude.
1	2	3	4	5	6	7	8	9	10
Canadian Stations—Con.	*Feet.*	° ′	*Inches.*	°F.	°F.	°F.	*Inches.*	°F.	*Ins.*
Halifax, N.S	97	44 39	29.88	44.6	....	44.7	30.01	44.8	20.57
Grand Manan, N.B	49	44 47	29.95	43.5	....	43.5	30.00	43.5	20.55
Yarmouth, N.S	65	43 50	29.93	44.0	....	44.1	30.00	44.2	20.55
Charlottetown, P.E.I	38	46 14	29.92	42.4	....	42.4	29.96	42.4	20.50
Chatham, N.B	21	47 3	29.95	40.0	....	40.0	29.97	40.0	20.47
Father Point, Que	30	48 31	29.94	35.3	....	35.3	29.96	35.3	20.38
Quebec, Que	296	46 48	29.66	40.0	....	40.3	29.99	40.6	20.48
Montreal, Que	187	45 30	29.79	43.2	....	43.4	30.00	43.6	20.54
Bissett, Ont	557	46 12	29.40	38.4	....	38.9	.....	39.4	.....
Ottawa, Ont	294	45 26	29.67	42.4	....	42.7	30.00	43.0	20.53
Kingston, Ont	285	44 13	29.65	44.4	....	44.7	29.96	45.0	20.55
Toronto, Ont	350	43 39	29.65	46.4	....	46.8	30.04	47.1	20.63
White River, Ont	1,232	48 20	28.64	31.8	...	34.2	30.03	36.5	20.41
Port Stanley, Ont	592	42 40	29.39	45.8	.....	46.4	30.04	47.0	20.62

TABLE III.—*Reduction data for* 1899—Continued.

Stations.	Elevation.	Latitude.	Mean observed pressure.	Mean observed temperature.	Mean dew-point.	Mean reduction temperature.	Mean pressure reduced to sea level.	Mean temperature reduced to sea level.	Mean pressure at 10,000 feet altitude.
1	2	3	4	5	6	7	8	9	10
Canadian Stations—Con.	*Feet.*	° ′	*Inches.*	°F.	°F.	°F.	*Inches.*	°F.	*Ins.*
Saugeen, Ont	656	44 30	29.30	43.7	....	44.4	30.02	45.1	20.57
Parry Sound, Ont	635	49 15	29.31	41.4	....	42.0	30.01	42.6	20.53
Port Arthur, Ont	644	48 27	29.27	35.0	....	35.0	29.99	35.6	20.40
Winnipeg, Man	760	49 53	29.14	34.2	....	35.0	29.99	35.8	20.40
Minnedosa, Man	1,690	50 10	28.13	32.5	....	35.0	29.99	36.7	20.40
Qu'Appelle, Assin	2,115	50 44	27.66	32.1	....	34.4	29.97	36.5	20.37
Medicine Hat, Assin	2,161	50 1	27.63	38.9	....	40.5	29.96	42.7	20.46
Swift Current, Assin	2,440	50 20	27.37	35.5	....	37.2	30.00	39.6	20.43
Calgary, Alberta	3,389	51 2	26.35	34.7	....	38.1	29.93	41.5	20.41
Edmonton, Alberta	2,158	53 14	27.59	34.6	....	37.7	29.93	39.9	20.41
Prince Albert, Sask	1,432	52 55	28.35	30.5	....	32.8	29.90	34.2	20.30
Battleford, Sask	1,620	52 41	28.21	33.3	....	35.1	29.99	36.7	20.40
Hamilton, Ber	151	32 23	29.93	69.8	....	70.0	30.09	70.2	21.04

TABLE IV.—*Resultant winds from observations at* 8 *a. m. and* 8 *p. m., daily, during the year* 1899.

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	242	199	131	301	n. 77 w.	173
Portland, Me	238	221	99	341	n. 85 w.	241
Northfield, Vt	237	208	45	122	s. 25 w.	188
Boston, Mass	192	207	113	345	s. 78 w.	118
Nantucket, Mass	227	224	149	215	n. 87 w.	66
Woods Hole, Mass	178	201	122	252	s. 81 w.	132
Block Island, R. I	228	203	143	334	n. 88 w.	192
New Haven, Conn	283	202	138	240	n. 52 w.	128
Middle Atlantic States.						
Albany, N. Y	232	296	94	224	s. 63 w.	140
Binghamton, N. Y.†	142	84	63	155	n. 58 w.	108
New York, N. Y	251	189	179	295	n. 63 w.	134
Harrisburg, Pa.†	130	66	113	148	n. 35 w.	65
Philadelphia, Pa	267	205	102	265	n. 60 w.	122
Atlantic City, N. J	219	234	154	291	s. 82 e.	141
Baltimore, Md	322	221	218	238	n. 11 w.	102
Washington, D. C	259	251	161	199	n. 78 w.	39
Lynchburg, Va	199	233	223	234	s. 18 w.	36
Norfolk, Va	235	272	250	117	s. 73 e.	136
Richmond, Va	257	289	165	151	s. 24 e.	35
South Atlantic States.						
Charlotte, N. C	243	248	269	171	s. 88 e.	98
Hatteras, N. C	313	302	140	188	n. 23 w.	121
Raleigh, N. C	288	208	164	220	n. 39 w.	98
Wilmington, N. C	248	203	214	235	n. 25 w.	50
Charleston, S. C	257	216	212	208	n. 6 e.	41
Augusta, Ga	235	198	204	253	n. 53 w.	61
Savannah, Ga	246	232	195	207	n. 63 w.	13
Jacksonville, Fla	251	226	263	195	n. 71 e.	72
Florida Peninsula.						
Jupiter, Fla	191	244	273	176	s. 62 e.	109
Key West, Fla	237	137	436	86	n. 74 e.	364
Tampa, Fla	303	129	256	207	n. 16 e.	177
Eastern Gulf States.						
Atlanta, Ga	213	187	243	208	n. 44 w.	36
Pensacola, Fla.†	172	123	165	93	n. 56 e.	86
Mobile, Ala	197	248	131	167	s. 35 w.	63
Montgomery, Ala	237	208	245	188	n. 63 e.	33
Meridian, Miss.†	118	110	114	119	n. 32 w.	9
Vicksburg, Miss	302	264	282	151	s. 65 e.	143
New Orleans, La	218	307	206	167	s 22 e.	108
Western Gulf States.						
Shreveport, La	175	171	149	141	n. 63 e.	9
Fort Smith, Ark	158	154	375	137	n. 88 e.	240
Little Rock, Ark	230	269	227	180	s. 44 e.	54
Corpus Christi, Tex	177	315	366	75	s. 64 e.	322
Fort Worth, Tex†	84	177	78	115	s. 21 w.	49
Galveston, Tex	163	317	323	123	s. 52 e.	253
Palestine, Tex	236	329	204	134	s. 37 e.	116
San Antonio, Tex	228	299	338	62	s. 7 w.	260
Ohio Valley and Tennessee.						
Chattanooga, Tenn	222	263	178	243	s. 58 w.	65
Knoxville, Tenn	287	185	216	236	n. 23 w.	55
Memphis, Tenn	262	272	174	191	s. 60 w.	20
Nashville, Tenn	252	233	170	231	n. 72 w.	63
Louisville, Ky	221	286	164	193	s. 24 w.	70
Evansville, Ind.†	112	140	110	74	s. 52 e.	46
Indianapolis, Ind	243	283	160	210	s. 51 w.	64
Cincinnati, Ohio	199	263	238	209	s. 25 e.	71
Columbus, Ohio	196	255	208	249	s. 57 w.	55
Pittsburg, Pa	264	219	152	271	n. 72 w.	126
Parkersburg, W. Va	220	279	167	211	s. 36 w.	74
Elkins, W. Va	239	224	110	253	n. 84 w.	145
Lower Lake Region.						
Buffalo, N. Y	155	221	163	341	s. 47 w.	248
Oswego, N. Y	159	333	300	232	s. 22 e.	184
Rochester, N. Y	161	254	133	376	s. 69 w.	256
Erie, Pa	171	242	136	322	s. 70 w.	202
Cleveland, Ohio	198	294	217	193	s. 14 e.	99
Toledo, Ohio	190	233	176	282	s. 68 w.	116
Detroit, Mich	222	227	173	276	s. 77 w.	160

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
Upper Lake Region.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Alpena, Mich	232	225	141	294	n. 87 w.	154
Escanaba, Mich	261	257	130	238	n. 89 w.	108
Grand Haven, Mich	239	205	214	249	n. 46 w.	49
Marquette, Mich	245	209	143	295	n. 77 w.	104
Port Huron, Mich	243	271	129	211	s. 71 w.	86
Sault Ste. Marie, Mich	155	149	278	278	n.	6
Chicago, Ill	220	238	227	237	s. 29 w.	21
Milwaukee, Wis	241	211	165	287	n. 76 w.	127
Green Bay, Wis	201	282	161	231	s. 41 w.	106
Duluth, Minn	319	145	184	304	n. 35 w.	208
North Dakota.						
Moorhead, Minn	261	226	216	270	n. 57 w.	65
Bismarck, N. Dak	304	117	219	269	n. 14 w.	192
Williston, N. Dak	279	294	241	264	s. 57 w.	28
Upper Mississippi Valley.						
St. Paul, Minn	220	251	188	271	s. 69 w.	90
La Crosse, Wis.†	91	167	84	96	s. 9 w.	77
Davenport, Iowa	199	213	214	268	s. 76 w.	56
Des Moines, Iowa	257	238	195	211	n. 40 w.	25
Dubuque, Iowa	217	254	178	263	s. 79 w.	187
Keokuk, Iowa	210	273	181	249	s. 47 w.	94
Cairo, Ill	245	291	164	172	s. 10 w.	47
Springfield, Ill	220	266	162	221	s. 53 w.	76
St. Louis, Mo	224	287	169	178	s. 7 w.	64
Missouri Valley.						
Columbia, Mo.*	106	125	122	95	s. 55 e.	33
Kansas City, Mo	248	267	261	164	s. 78 e.	98
Springfield, Mo	196	334	230	116	s. 88 e.	178
Lincoln, Nebr	266	286	219	127	s. 78 e.	94
Omaha, Nebr	264	238	224	162	s. 67 w.	68
Sioux City, Iowa†	127	139	88	96	s. 34 w.	14
Pierre, S. Dak	232	189	268	214	n. 51 e.	70
Huron, S. Dak	224	214	239	250	n. 48 w.	15
Yankton, S. Dak†	96	77	88	156	n. 74 w.	71
Northern Slope.						
Helena, Mont	157	263	45	432	s. 75 w.	424
Rapid City, S. Dak	261	150	177	324	s. 59 w.	175
Cheyenne, Wyo	274	183	69	358	n. 78 w.	304
Lander, Wyo	171	298	159	317	s. 51 w.	206
North Platte, Nebr	216	350	183	250	s. 32 w.	153
Middle Slope.						
Denver, Colo	238	286	157	193	s. 37 w	60
Pueblo, Colo	247	165	231	254	n. 16 w.	86
Concordia, Kans	178	321	191	135	s. 22 e.	155
Dodge, Kans	250	271	237	142	s. 84 e.	201
Wichita, Kans	230	353	185	77	s. 41 e.	164
Oklahoma, Okla	213	361	173	88	s. 28 e.	170
Southern Slope.						
Abilene, Tex	165	737	536	247	s. 25 e.	636
Amarillo, Tex	188	357	144	160	s. 5 w.	168
Southern Plateau.						
El Paso, Tex	256	98	220	343	n. 37 w.	200
Santa Fe, N. Mex	220	266	267	183	s. 61 e.	96
Phenix, Ariz	167	109	306	270	n. 32 e.	68
Yuma, Ariz	251	177	177	318	n. 63 w.	157
Independence, Cal	275	195	115	345	n. 71 w.	244
Middle Plateau.						
Carson City, Nev	186	213	99	375	s. 84 w.	282
Winnemucca, Nev	212	259	174	267	s. 62 w.	104
Salt Lake City, Utah	210	269	236	183	s. 42 e.	80
Grand Junction, Colo	244	174	255	244	n. 10 e.	71
Northern Plateau.						
Boise, Idaho	171	198	233	209	s. 42 e.	36
Spokane, Wash	138	328	203	202	s.	190
Walla Walla, Wash	85	454	107	194	s. 14 w.	381
North Pacific Coast Region.						
Port Crescent, Wash.*	7	60	107	239	s. 68 w.	142
Seattle, Wash	165	342	224	150	s. 21 e.	193
Tacoma, Wash	189	321	72	305	s. 61 w.	264
Portland, Oreg	214	300	152	224	s. 40 w.	112
Roseburg, Oreg	295	179	246	195	n. 23 e.	130

*From observations at 8 p. m. only.

†From observations at 8 a. m. only.

TABLE IV.—*Resultant winds during the year* 1899.—Continued.

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
	Hours.	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Middle Pacific Coast Region.						
Eureka, Cal	268	246	151	292	n. 77 w.	144
Red Bluff, Cal	301	246	284	154	n. 67 e.	75
Sacramento, Cal	180	386	162	192	s. 9 w.	207
San Francisco, Cal	102	209	56	485	s. 76 w.	444
South Pacific Coast Region.						
Fresno, Cal	339	101	117	391	n. 48 w.	361
Los Angeles, Cal	124	210	64	414	s. 76 w.	361
San Luis Obispo, Cal	383	129	43	272	n. 49 w.	305
West Indies.						
Basseterre, St. Kitts Island	179	48	598	10	n. 77 e.	600
Bridgetown, Barbados	141	101	618	2	n. 87 e.	630
Port of Spain, Trinidad	126	81	571	34	n. 86 e.	542
San Juan, Puerto Rico	43	303	311	42	s. 46 e.	375
Santiago de Cuba, Cuba	368	173	289	66	n. 48 e.	297
Santo Domingo, S. Domingo, W. I.	536	79	129	58	n. 8 e.	475
Willemstad, Curaçao	48	50	685	0	e.	685

TABLE V.—*Total number of days with thunderstorms at selected stations,* 1899.

State and station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Alabama.													
Mobile	2	2	4	2	2	7	15	17	6	0	2	1	60
Montgomery	2	2	4	4	4	8	11	13	2	2	1	1	54
Scottsboro	0	5	6	7	8	12	9	21	5	0	0	0	73
Arizona.													
Defiance, Fort	0	0	0	0	0	0	5	3	0	0	0	0	8
Holbrook	0	0	0	0	0	7	0	7	5	0	0	0	19
Phenix	0	0	0	0	0	3	5	4	1	1	0	0	14
Yuma	0	0	0	0	0	0	1	0	0	0	0	0	1
Arkansas.													
Fort Smith	1	1	3	2	7	5	6	1	0	0	0	1	27
Keesees Ferry	4	1	6	6	7	7	13	8	4	0	8	1	65
Little Rock	4	1	4	1	10	5	11	4	2	0	0	1	43
Pocahontas	2	0	6	3	11	5	9	5	2	2	3	0	48
California.													
Eureka	0	0	0	0	0	0	0	0	0	0	2	1	3
Fresno	0	0	1	0	0	0	0	0	0	2	0	0	3
Independence	0	0	0	0	0	1	2	2	0	0	0	0	5
Los Angeles	1	0	0	0	0	0	0	0	1	0	0	0	2
Mount Tamalpais	0	0	0	0	0	0	0	0	0	1	1	1	3
Red Bluff	0	0	1	0	0	0	0	0	1	0	0	0	2
Sacramento	0	0	0	0	0	0	0	2	0	0	0	0	2
San Diego	0	0	0	0	0	0	0	0	0	1	0	0	1
San Francisco	0	0	0	0	0	0	0	0	0	0	0	0	0
San Luis Obispo	0	0	0	0	0	0	0	0	0	0	0	0	0
Colorado.													
Denver	0	0	0	1	7	7	15	11	1	0	0	0	42
Durango	0	0	0	0	0	3	0	4	1	0	0	0	8
Fort Collins	0	0	0	0	5	0	10	9	1	0	0	0	25
Grand Junction	0	0	0	0	2	5	9	11	2	0	0	0	29
Pueblo	0	0	1	0	2	6	13	8	1	0	0	0	31
Connecticut.													
Hartford	1	0	2	1	4	9	9	3	2	0	0	0	31
New Haven	1	0	2	1	4	8	5	3	1	0	0	0	25
Dist. of Columbia.													
Washington	1	1	3	1	8	5	14	10	2	0	0	0	45
Florida.													
Jacksonville	1	2	4	2	6	12	12	15	6	2	0	1	63
Jupiter	1	5	5	4	6	8	14	12	13	0	1	1	70
Key West	1	1	0	1	3	2	7	13	7	2	1	0	38
Merritt Island	3	6	3	2	4	13	25	23	19	5	0	0	103
Myers	1	2	4	3	8	25	30	30	30	1	1	0	135
Pensacola	0	1	3	0	0	2	6	8	12	0	0	0	32
Tampa	2	4	1	3	3	16	11	12	12	2	0	0	66
Georgia.													
Allentown	1	3	7	2	9	5	7	9	2	4	1	0	48
Atlanta	0	2	6	3	7	6	7	6	2	3	2	0	44
Augusta	0	2	2	1	2	5	6	10	5	0	0	0	33
Clayton	1	1	5	3	6	2	3	2	2	1	0	0	26
Poulan	2	1	0	1	1	4	4	5	1	0	0	0	19
Savannah	1	2	4	2	8	6	11	15	2	1	0	0	52
Idaho.													
Boise	0	0	1	0	2	4	2	4	1	1	1	0	15
Burnside	0	0	0	0	3	5	15	6	0	0	0	0	29
Downey	0	0	0	0	3	1	8	4	0	0	1	0	17
Murray	0	0	0	0	0	0	1	4	1	0	0	0	6
Ola	0	0	0	0	3	2	5	4	1	2	1	0	18
Illinois.													
Cairo	2	1	6	3	13	9	8	10	4	1	3	0	60
Chicago	0	0	0	1	12	7	6	4	3	0	1	0	34
Olney	1	1	6	3	11	8	9	10	2	0	2	0	53
Peoria	0	0	2	2	7	5	2	1	3	0	0	0	22
Rantoul	0	0	2	3	9	7	6	6	4	1	1	0	39
Springfield	0	0	2	1	13	7	6	5	5	0	2	1	42
Winnebago	0	0	0	4	11	5	5	5	0	1	2	0	33
Indiana.													
Butlerville	2	0	2	0	5	0	4	0	0	1	0	0	14
Cambridge City	0	1	3	1	9	6	9	8	5	0	1	0	43
Evansville	3	0	5	1	8	6	5	7	2	1	1	0	39
Huntington	0	1	2	1	4	1	0	4	1	1	1	0	16
Indianapolis	0	2	3	0	9	6	5	6	5	0	1	0	37
Worthington	0	1	2	0	5	4	3	2	0	1	0	0	18
Iowa.													
Davenport	0	0	0	3	11	8	4	5	2	2	1	0	63

TABLE V.—*Total number of days with thunderstorms, etc.*—Continued.

State and station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Iowa—Cont'd.													
Des Moines	0	0	1	8	13	10	7	9	3	2	2	0	55
Dubuque	0	0	2	6	13	8	7	10	4	4	0	0	54
Keokuk	0	0	1	3	11	8	7	7	5	1	1	0	44
Sioux City	0	0	1	3	7	7	5	8	4	4	0	0	39
Kansas.													
Concordia	0	0	1	2	10	9	9	7	1	4	0	0	43
Dodge	0	0	0	0	7	9	8	10	2	5	0	0	41
Topeka	0	0	2	3	13	9	10	7	4	0	1	0	49
Wichita	0	1	4	5	13	7	9	8	5	2	0	0	54
Kentucky.													
Hopkinsville	1	2	2	0	5	0	2	5	0	1	0	0	18
Lexington	0	1	7	0	9	5	6	3	0	1	0	0	32
Louisville	1	1	8	1	8	7	6	6	1	1	0	0	40
Louisiana.													
Melville	1	0	4	0	0	8	11	29	8	0	2	1	64
New Orleans	0	2	2	2	1	8	9	8	3	1	0	1	37
Shreveport	2	1	4	2	5	6	6	7	1	1	0	2	37
Maine.													
Belfast	0	0	1	0	2	6	6	1	1	0	0	0	17
Eastport	0	0	1	0	0	6	3	0	1	0	0	0	11
Farmington	0	0	0	0	1	3	4	0	1	0	0	0	9
Portland	0	0	0	0	2	5	7	3	2	0	0	0	19
Maryland.													
Baltimore	1	1	4	2	6	6	9	6	3	0	0	0	38
Frostburg	0	0	0	1	8	3	0	0	1	0	0	0	13
Princess Anne	1	2	3	1	4	4	3	2	3	0	0	0	23
Massachusetts.													
Adams	0	0	1	1	0	2	2	0	1	0	0	0	7
Boston	1	0	1	1	1	4	4	1	1	0	0	0	14
Monson	0	0	1	1	0	3	0	0	1	0	0	0	6
Nantucket	0	0	4	0	1	4	5	3	1	0	0	1	19
New Bedford	0	0	1	1	0	3	4	0	1	0	0	0	10
Vineyard Haven	0	0	1	0	1	4	2	2	0	0	0	0	10
Woods Hole	0	0	1	0	1	4	3	2	2	0	0	0	12
Michigan.													
Alpena	0	0	0	4	3	7	3	3	1	2	0	0	23
Detroit	0	1	2	2	9	6	8	3	5	0	0	0	31
Escanaba	0	0	1	5	5	8	8	8	6	1	0	0	42
Grand Haven	0	0	0	1	7	3	3	1	4	1	0	0	20
Lansing	0	1	0	0	6	2	2	2	3	0	0	0	16
Marquette	0	0	0	4	4	5	6	8	3	3	0	0	33
Port Huron	0	1	1	2	5	7	3	1	1	1	0	0	22
Sault Ste. Marie	0	0	0	4	5	3	7	4	3	3	0	0	29
Minnesota.													
Duluth	0	0	0	3	7	6	7	9	3	2	0	0	37
Luverne	0	0	0	0	2	9	6	2	0	0	0	0	19
Moorhead	0	0	0	1	6	3	6	6	0	1	0	0	23
St. Cloud	0	0	0	2	3	2	5	3	2	2	0	0	19
St. Paul	0	0	1	3	9	9	7	7	6	2	0	0	44
Mississippi.													
Biloxi	0	1	3	0	2	6	9	5	0	0	2	0	28
Meridian	1	1	7	1	4	6	16	11	2	3	1	1	54
Vicksburg	3	4	6	0	3	14	15	14	5	0	0	1	65
Watervalley	3	3	5	2	7	4	11	7	3	1	1	0	47
Missouri.													
Columbia	0	1	2	3	14	9	8	11	4	1	3	0	56
Hannibal	0	1	3	2	11	6	8	6	4	1	2	0	44
Kansas City	0	1	2	3	8	12	8	12	3	0	5	0	54
St. Louis	0	1	3	2	7	7	6	7	3	1	1	0	38
Springfield	0	2	4	5	14	9	7	10	0	0	5	0	56
Montana.													
Havre	0	0	0	0	3	7	7	10	2	0	0	0	29
Helena	0	0	0	0	2	2	13	6	4	0	0	0	27
Kipp	0	0	0	0	5	0	0	0	4	0	0	1	10
Manhattan	0	0	0	1	0	2	7	5	0	0	0	0	15
Miles City	0	0	0	2	2	1	0	0	0	0	0	0	5
Missoula	0	0	0	0	0	0	2	0	0	0	0	0	2
Nebraska.													
Lincoln	0	0	1	3	11	12	4	8	2	1	0	0	42
North Platte	0	0	0	2	8	9	6	7	2	1	0	0	35
Omaha	0	0	2	4	14	9	5	10	2	2	0	0	48
Nevada.													
Carson City	0	0	0	0	0	1	2	3	0	0	0	0	6
Winnemucca	0	0	0	0	3	1	3	3	1	0	0	0	11
New Hampshire.													
Bethlehem	0	0	0	1	3	3	3	1	1	0	0	0	12
Nashua	0	0	1	1	2	1	3	1	0	0	0	0	9
New Jersey.													
Atlantic City	1	0	1	2	2	4	4	6	2	0	0	0	22
Somerville	1	0	3	0	4	7	13	10	6	0	0	1	45
New Mexico.													
Santa Fe	0	0	1	3	1	9	20	5	7	0	1	0	47
Whiteoaks	0	0	0	1	0	3	6	2	0	0	0	0	12
New York.													
Albany	0	0	0	1	1	6	6	4	4	0	0	0	22
Binghamton	0	0	0	2	5	10	6	5	1	0	0	0	29
Buffalo	0	0	0	2	3	6	7	6	2	2	0	0	28
New York	2	0	3	0	4	7	6	5	2	0	0	0	29
Oswego	0	0	1	1	4	7	4	2	2	0	0	0	21
Rochester	0	0	1	1	4	5	9	3	1	0	0	0	24
South Canisteo	0	0	0	3	3	8	7	3	3	1	0	0	38
North Carolina.													
Charlotte	0	1	6	1	7	1	8	8	5	1	0	0	38
Hatteras	0	1	5	1	2	4	4	2	1	0	1	0	21
Linville	0	1	4	0	5	4	3	6	3	0	0	0	26
Raleigh	0	0	5	2	8	7	11	7	6	1	1	0	48
Wilmington	1	0	3	2	6	9	11	8	1	1	0	0	42
North Dakota.													
Bismarck	0	0	0	1	6	6	4	6	1	0	0	0	24
Dickinson	0	0	0	2	1	1	3	0	0	0	0	0	7
Williston	0	0	0	1	1	4	2	1	0	0	0	0	9
Ohio.													
Cincinnati	1	0	7	1	7	7	5	7	3	0	0	0	38

TABLE V.—*Total number of days with thunderstorms, etc.*—Continued.

State and station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Ohio—Con.													
Cleveland	0	0	2	4	9	7	6	3	3	0	0	0	34
Columbus	1	1	3	2	5	4	4	5	3	0	0	0	28
Sandusky	0	0	2	3	9	8	5	3	4	0	0	0	34
Toledo	0	1	2	2	8	5	4	4	5	1	0	0	32
Oklahoma.													
Oklahoma	1	1	1	3	10	4	6	2	5	1	3	0	37
Oregon.													
Baker City	0	0	0	0	1	1	3	2	2	0	1	0	10
Portland	0	0	0	0	1	0	2	0	0	0	0	0	3
Roseburg	0	0	0	0	0	0	0	0	1	0	0	0	1
Pennsylvania.													
Dushore	0	0	1	2	4	4	3	5	2	0	0	0	21
Erie	0	0	1	1	7	7	10	1	3	0	0	0	30
Harrisburg	0	0	0	1	5	10	5	7	4	0	0	0	32
Philadelphia	1	1	2	1	4	9	5	6	3	0	1	0	33
Pittsburg	0	0	1	3	7	7	6	6	3	0	0	0	33
Rhode Island.													
Block Island	1	0	3	0	1	6	5	4	3	1	0	0	24
Narragansett	0	0	1	0	1	3	4	1	0	0	0	0	10
South Carolina.													
Charleston	1	1	5	1	5	10	8	11	5	2	1	0	50
Columbia	0	1	4	1	2	7	5	7	3	1	0	0	31
South Dakota.													
Huron	0	0	0	2	10	13	7	7	4	2	0	0	45
Pierre	0	0	0	2	7	10	8	10	4	2	1	0	44
Rapid City	0	0	0	1	5	11	10	4	2	0	0	0	32
Yankton	0	0	0	3	8	10	5	10	2	3	0	0	41
Tennessee.													
Chattanooga	0	5	6	2	14	11	11	12	5	2	1	0	69
Knoxville	0	0	7	1	9	7	9	6	5	1	0	0	45
Memphis	2	2	6	0	8	3	5	7	1	1	2	2	39
Nashville	0	4	7	2	9	4	4	7	4	0	2	1	44
Texas.													
Abilene	0	0	0	4	9	1	4	0	0	0	1	1	20
Amarillo	0	0	0	1	8	10	10	6	5	2	2	0	44
Corpus Christi	0	1	1	2	1	5	4	0	7	3	2	0	26
El Paso	0	0	1	0	0	4	10	6	2	0	0	0	23
Fort Worth	0	0	0	0	3	2	4	0	1	0	1	0	11
Galveston	5	1	2	3	0	2	4	7	7	1	4	1	37
Palestine	2	0	1	0	4	4	3	3	0	0	0	0	17
San Antonio	1	0	0	4	3	3	5	0	0	1	1	0	18
Utah.													
Salt Lake City	0	0	0	0	3	4	10	8	1	1	1	0	28
Vermont.													
Northfield	0	0	1	1	2	5	8	2	2	0	0	0	21
Vernon	1	0	1	1	2	0	9	4	3	1	0	0	22
Virginia.													
Cape Henry	0	2	6	3	4	7	11	4	0	0	0	0	37
Dale Enterprise	0	1	4	1	6	3	10	5	5	0	0	0	35
Lynchburg	0	0	2	2	4	5	8	7	3	0	1	0	32
Norfolk	0	1	5	2	3	5	8	3	1	1	1	0	30
Richmond	1	0	3	0	4	4	4	5	2	0	0	0	23
Wythevill e	0	1	4	2	7	6	4	8	5	0	0	0	37
Washington.													
Port Crescent	0	0	0	0	0	1	0	0	0	0	0	0	1
Seattle	0	0	0	0	0	0	1	0	1	0	1	0	3
Spokane	0	0	0	0	0	1	2	1	1	0	0	0	5
Tacoma	0	0	0	0	0	0	0	0	0	0	0	0	0
Walla Walla	0	0	0	1	1	0	1	0	1	0	0	0	4
West Virginia.													
Elkins	0	1	3	5	10	11	9	6	5	0	0	0	50
Parkersburg	0	1	2	2	9	7	8	8	4	0	0	0	41
Uppertract	0	0	1	4	9	7	12	11	4	0	0	0	48
Wisconsin.													
Green Bay	0	0	1	3	6	6	5	5	5	1	0	0	32
La Crosse	0	0	0	4	6	10	1	6	4	2	0	0	33
Milwaukee	0	0	0	5	8	9	4	6	3	2	1	0	38
Wyoming.													
Cheyenne	0	0	0	0	8	9	15	10	2	0	0	0	44
Lander	0	0	0	0	0	2	5	3	1	0	0	0	11

TABLE VI.—*Number of days on which thunderstorms were reported*, 1899.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Alabama	3	10	17	9	13	21	23	30	12	7	6	7	158
Arizona	0	1	3	6	3	17	31	24	15	8	3	8	119
Arkansas	12	5	13	12	25	18	25	25	9	5	12	5	166
California	2	2	7	6	11	2	5	11	1	11	3	11	72
Colorado	0	3	8	9	19	26	30	22	13	5	2	5	142
Connecticut	3	0	2	5	9	12	14	10	7	0	0	0	62
Delaware	1	1	3	3	5	9	8	8	3	0	1	0	42
Dist. of Columbia	1	1	3	1	8	5	14	10	2	0	0	0	45
Florida	5	15	16	8	20	27	29	31	26	9	3	9	198
Georgia	7	9	18	7	19	19	23	26	12	5	3	5	153
Idaho	0	0	2	4	12	17	26	20	6	3	2	3	95
Illinois	2	3	15	15	28	26	21	24	16	6	10	6	172
Indiana	7	3	11	9	24	18	18	18	11	3	5	3	130

TABLE VI.—*Number of days on which thunderstorms were reported*—Con.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Indian Territory	0	1	2	3	19	5	13	2	1	2	6	2	56
Iowa	0	1	9	15	24	24	24	23	20	11	5	11	167
Kansas	0	3	8	17	28	23	24	24	12	9	14	9	171
Kentucky	6	6	21	4	20	21	16	17	12	3	4	3	133
Louisiana	6	9	13	11	13	23	29	31	13	8	9	8	173
Maine	0	0	1	0	4	14	17	5	5	0	0	0	46
Maryland	1	2	14	7	18	17	21	17	14	6	3	6	126
Massachusetts	4	0	9	5	6	15	14	8	6	1	0	1	69
Michigan	0	2	4	19	18	22	27	22	13	12	2	12	153
Minnesota	0	0	3	9	23	23	19	25	14	11	4	11	142
Mississippi	9	9	13	10	17	23	28	30	12	5	6	5	167
Missouri	2	3	18	15	29	25	21	22	15	6	15	6	177
Montana	0	0	0	4	11	23	24	18	7	1	0	1	89
Nebraska	0	0	5	8	27	26	24	30	10	7	8	7	152
Nevada	0	0	3	1	5	2	14	8	4	0	0	0	37
New Hampshire	0	0	5	4	5	13	12	10	7	0	0	0	56
New Jersey	3	1	11	5	10	15	19	16	10	0	2	0	92
New Mexico	0	1	1	6	8	15	30	17	14	6	2	6	106
New York	3	0	5	10	18	22	27	16	14	3	0	3	121
North Carolina	2	1	20	10	21	19	23	24	16	3	3	3	145
North Dakota	0	2	0	5	12	20	22	17	3	2	1	2	86
Ohio	4	3	21	18	20	22	24	15	15	2	4	2	150
Oklahoma	2	1	5	9	22	15	18	5	8	4	5	4	98
Oregon	2	0	1	6	14	0	13	11	7	5	6	5	70
Pennsylvania	3	1	9	7	16	24	26	19	22	0	2	0	129
Rhode Island	1	0	4	3	8	8	8	4	3	2	0	2	37
South Carolina	4	7	18	7	17	21	20	24	15	7	4	7	151
South Dakota	0	1	0	7	25	27	25	27	10	5	2	5	134
Tennessee	3	9	20	11	21	24	19	26	17	5	5	5	165
Texas	11	8	8	10	23	23	23	15	12	10	8	10	161
Utah	0	0	7	7	11	14	26	21	6	7	1	7	107
Vermont	1	0	1	6	2	10	17	7	6	0	0	0	50
Virginia	3	4	13	8	18	20	18	13	15	1	2	1	116
Washington	2	0	2	6	11	11	8	7	8	3	4	3	65
West Virginia	1	1	8	10	22	22	24	16	14	0	2	0	120
Wisconsin	0	0	4	14	20	20	24	21	13	10	4	10	140
Wyoming	0	4	2	4	14	11	23	16	5	1	0	1	81
Total	116	133	406	395	790	879	1,081	888	531	220	183	220	5,792

TABLE VII.—*Number of days on which auroras were reported*, 1899.

Alabama	0	0	0	0	0	0	0	0	0	0	0	0	0
Arizona	0	0	0	0	0	0	0	0	0	0	0	0	0
Arkansas	0	0	0	0	0	0	0	0	0	0	0	0	0
California	0	0	0	0	0	0	0	0	0	0	0	0	0
Colorado	0	0	0	0	0	0	0	0	0	0	0	0	0
Connecticut	0	1	0	0	1	1	0	0	0	0	0	0	3
Delaware	0	0	0	0	0	1	0	0	0	0	0	0	1
Dist. of Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	0	0	0	0	0	0	0	0	0	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0
Idaho	0	0	0	0	3	0	3	0	1	0	0	0	7
Illinois	7	6	0	0	3	1	2	0	2	2	1	2	26
Indiana	0	3	0	1	1	0	2	1	0	0	0	0	8
Indian Territory	0	0	0	0	0	0	0	0	0	0	0	0	0
Iowa	2	4	2	0	3	4	2	0	4	1	0	1	23
Kansas	0	0	0	0	0	0	1	1	0	0	1	0	3
Kentucky	0	0	0	0	0	0	0	0	0	0	0	0	0
Louisiana	0	0	0	0	0	0	0	0	0	0	0	0	0
Maine	1	3	2	3	3	2	1	2	2	3	0	3	25
Maryland	0	2	1	0	0	1	0	0	0	1	0	1	6
Massachusetts	2	2	0	0	3	2	3	3	1	0	0	0	16
Michigan	6	5	0	11	5	3	1	2	3	1	0	1	38
Minnesota	4	6	1	3	4	4	1	5	4	3	0	3	38
Mississippi	0	0	0	0	0	0	0	0	0	0	0	0	0
Missouri	0	0	0	0	0	1	0	0	1	0	1	0	3
Montana	1	0	8	6	5	4	2	4	6	4	3	4	47
Nebraska	2	3	1	1	2	1	0	0	1	0	0	0	11
Nevada	0	0	0	0	0	0	0	0	0	0	0	0	0
New Hampshire	4	2	1	3	6	4	2	3	3	1	1	1	31
New Jersey	3	0	0	1	1	1	2	2	1	0	0	0	11
New Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	2	9	2	1	3	4	2	3	1	1	0	1	29
North Carolina	0	0	0	2	1	0	0	0	0	0	0	0	3
North Dakota	4	11	5	6	2	3	1	8	6	2	2	2	52
Ohio	5	4	5	5	3	3	8	4	0	0	5	0	42
Oklahoma	1	1	0	0	0	0	0	0	0	0	0	0	2
Oregon	0	0	0	0	3	3	0	0	1	0	1	0	8
Pennsylvania	0	1	0	0	1	1	0	0	1	0	1	0	5
Rhode Island	1	0	0	0	0	1	0	0	0	0	0	0	2
South Carolina	0	0	0	0	0	0	0	0	0	0	0	0	0
South Dakota	3	5	1	1	4	3	5	1	5	1	0	1	30
Tennessee	0	1	0	0	0	0	0	0	0	0	0	0	1
Texas	0	0	0	0	0	0	0	0	0	0	0	0	0
Utah	0	0	0	0	0	0	0	0	0	0	0	0	0
Vermont	1	1	1	0	5	1	1	0	0	1	0	1	12
Virginia	0	0	1	0	0	0	0	0	0	0	0	0	0
Washington	0	1	1	0	4	4	0	2	0	0	0	0	12
West Virginia	0	1	0	0	0	0	0	0	0	0	0	0	1
Wisconsin	3	5	2	2	5	3	3	3	5	2	0	2	35
Wyoming	1	0	1	4	1	0	3	0	1	0	0	0	11

Chart I. Sea-Level Pressure and Temperature and Resultant Winds, 1899.

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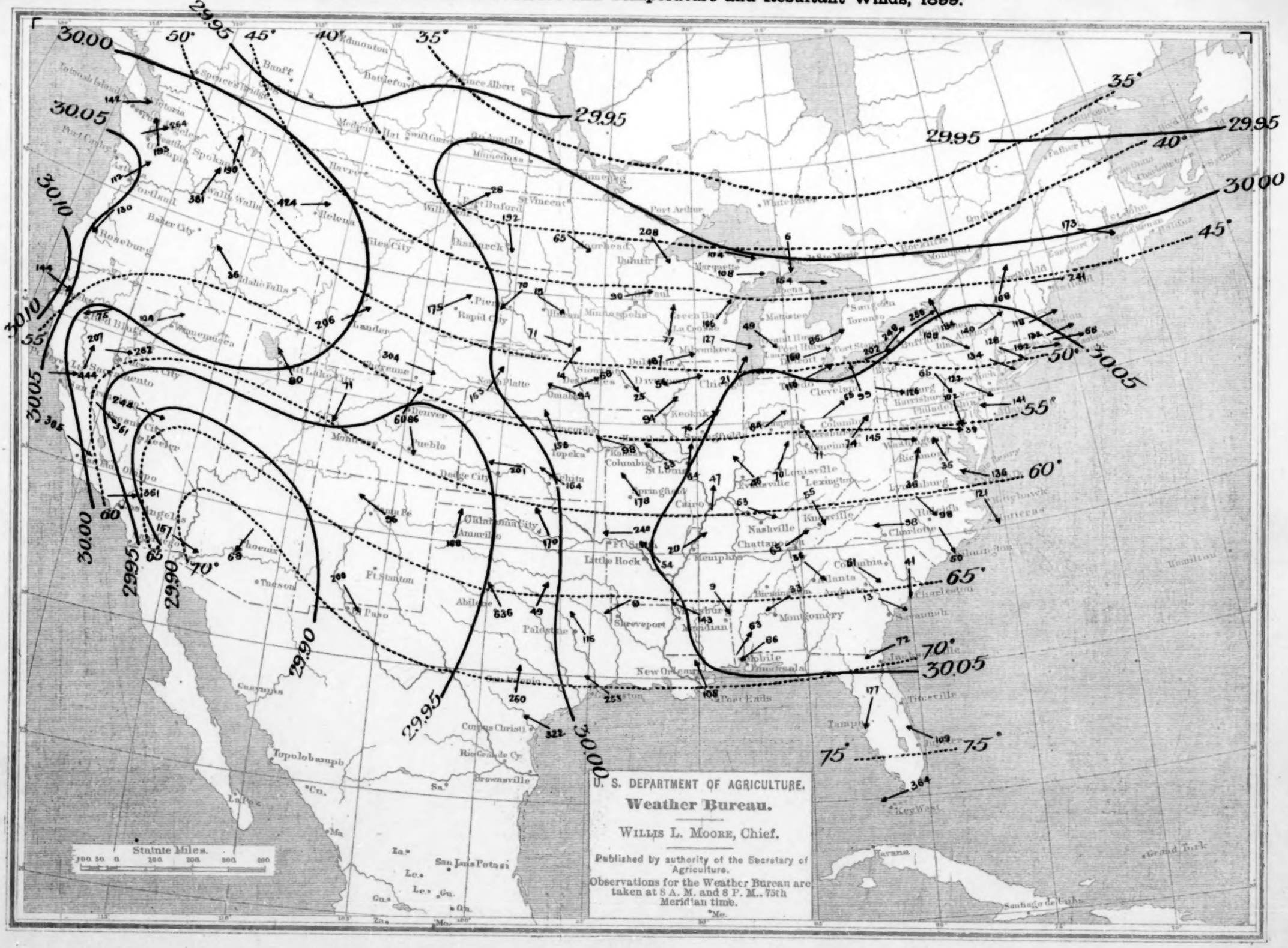

Chart II. High-Level Pressure (10,000 feet), 1899.

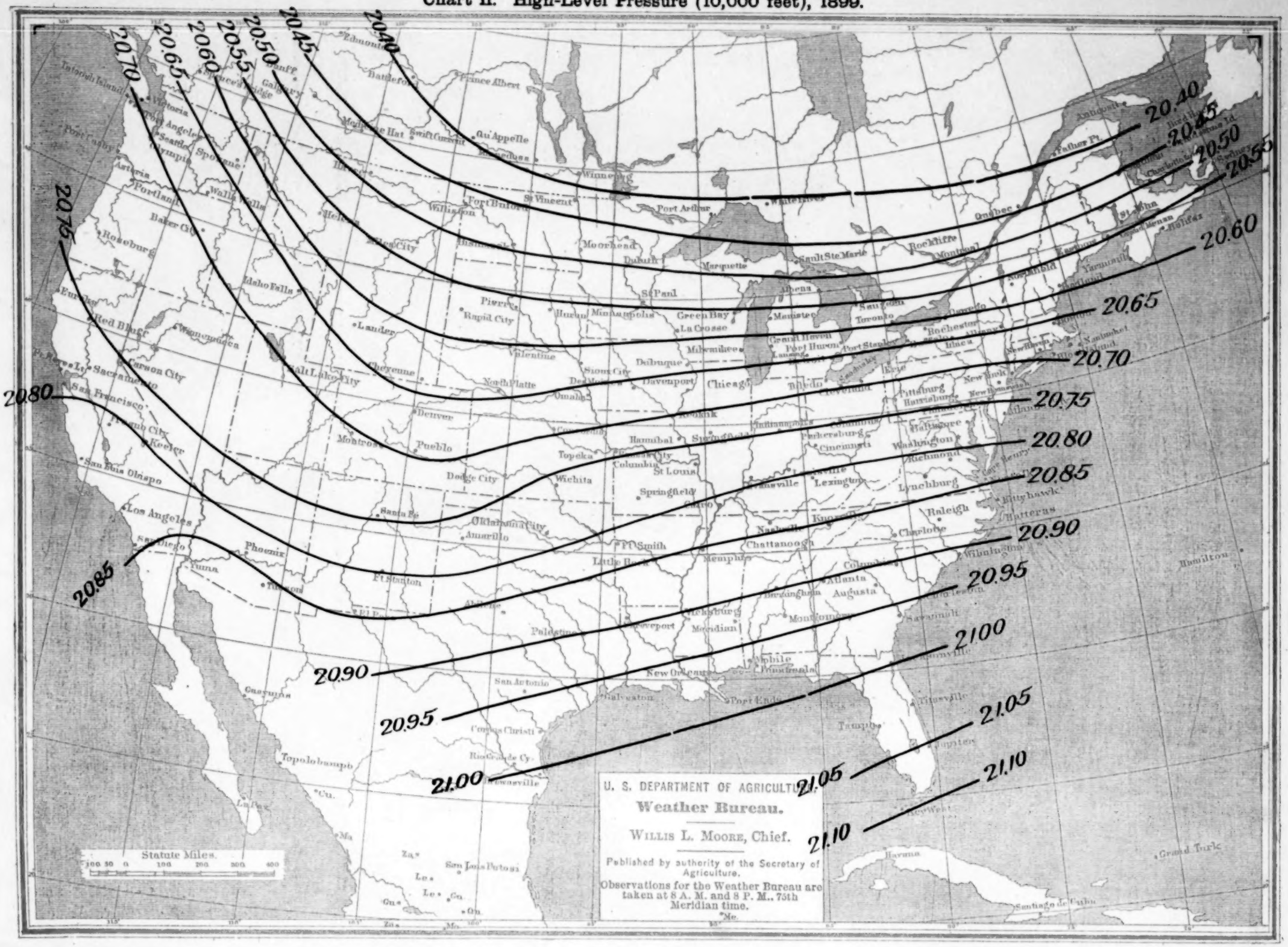

Chart III. Surface Temperatures.

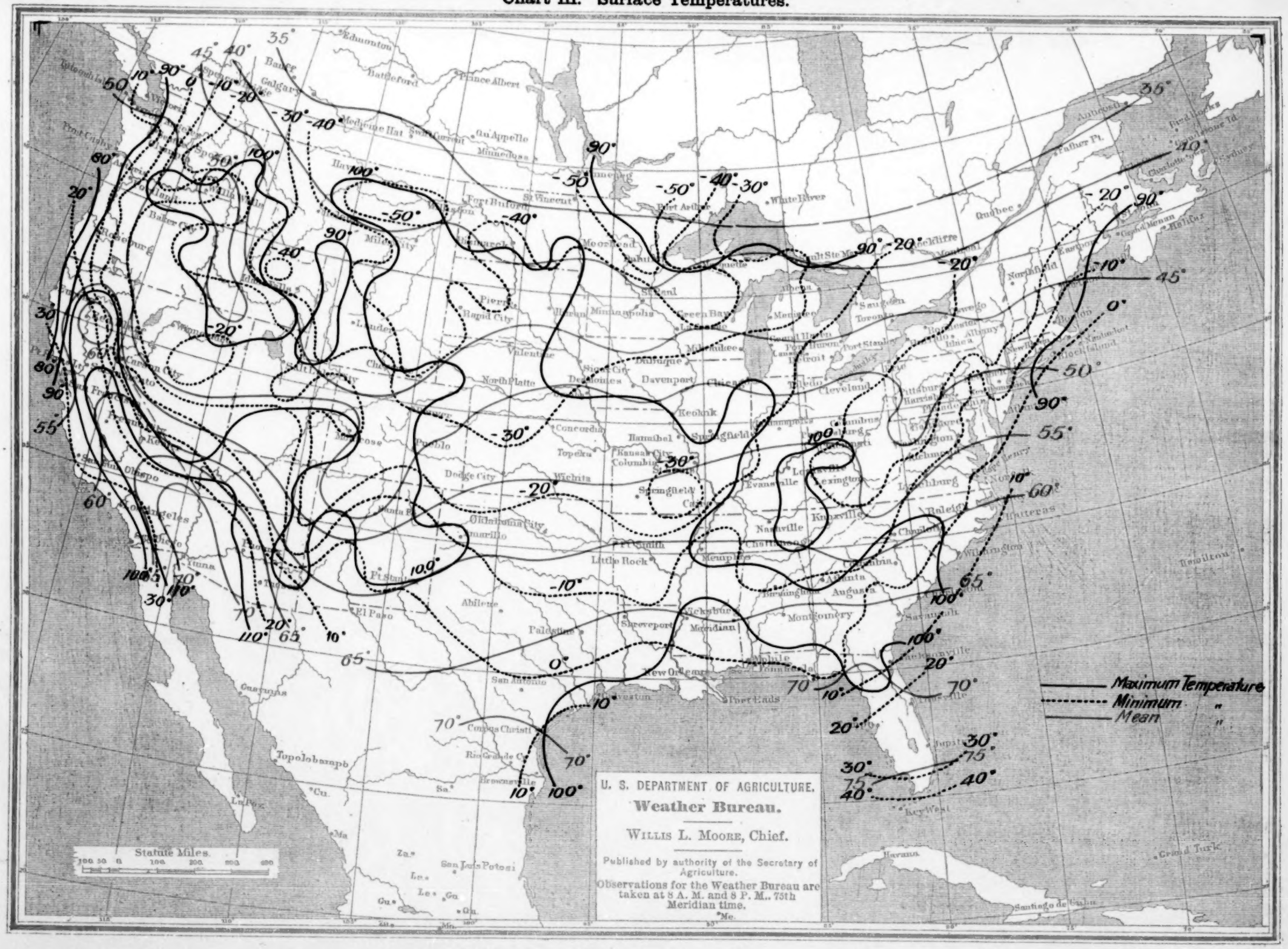

Chart IV. Total Annual Precipitation, 1899.

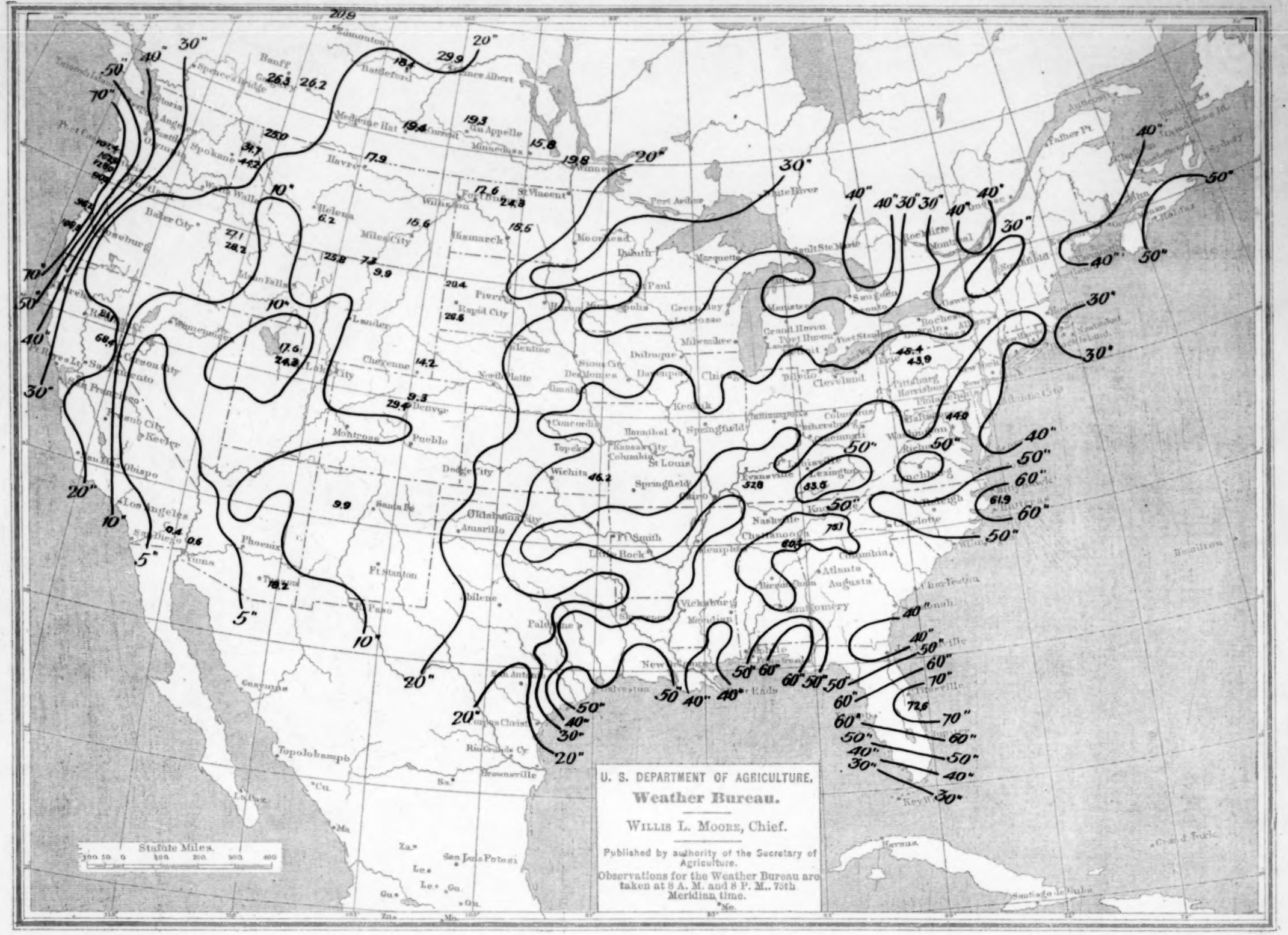

Chart V. Total Number of Thunderstorm Days, 1899.

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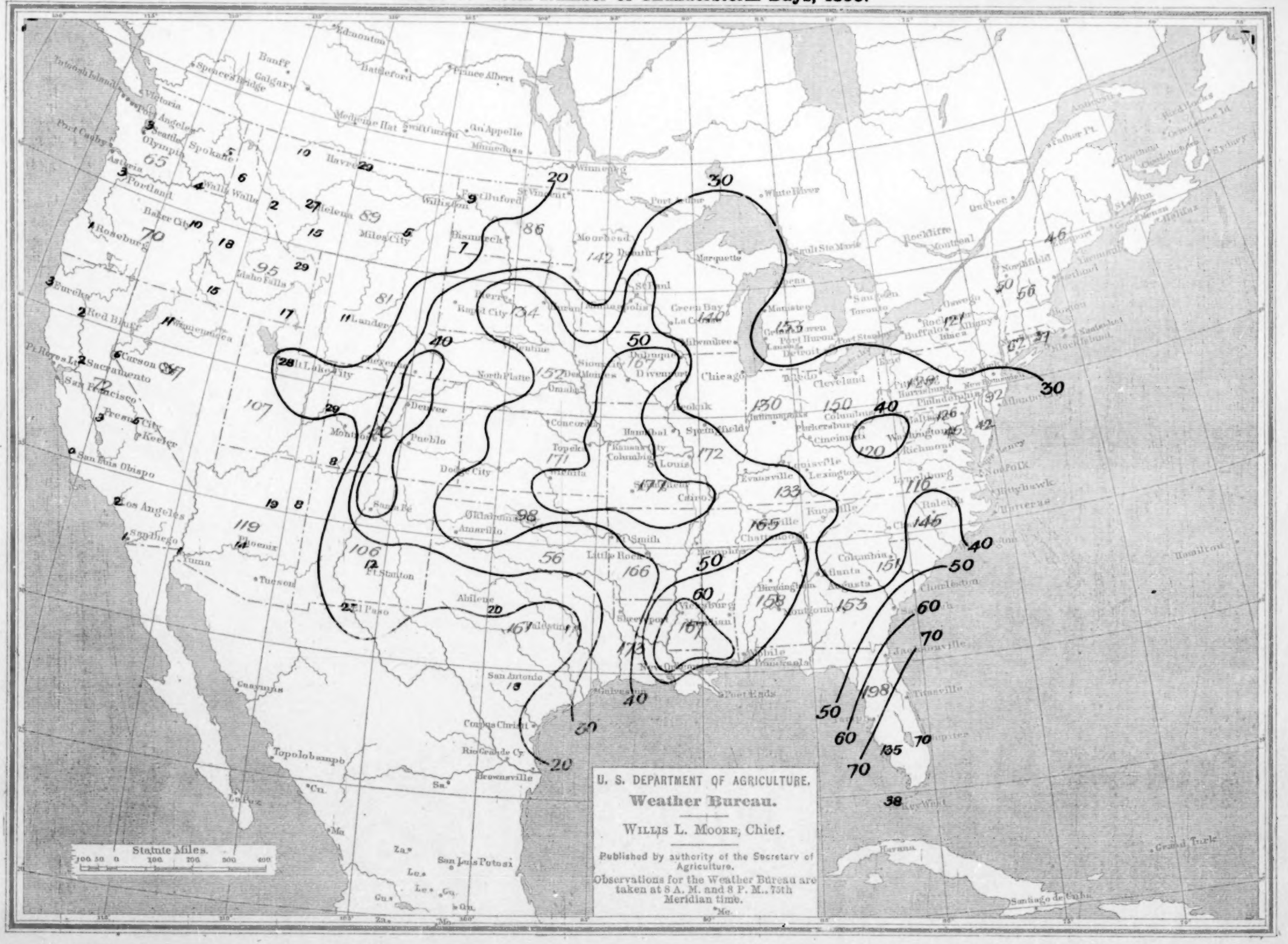

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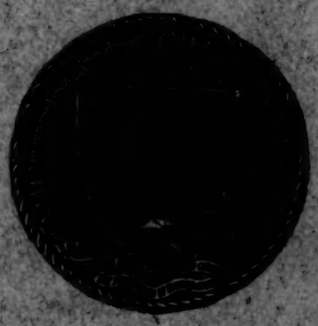

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March 19, 1900.

Communications relative to the MONTHLY WEATHER REVIEW may be addressed to the "Chief of Weather Bureau, for Editor of the Monthly Weather Review."